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Occupation based constraint-induced movement therapy

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OCCUPATION BASED

CONSTRAINT-INDUCED MOVEMENT THERAPY

By

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An Abstract

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ABSTRACT

Constraint-Induced Movement Therapy (CI therapy) is a motor remediation technique used with people exhibiting hemiparesis as result of neurological damage. This relatively new type of treatment has been shown to effectively increase the amount of use of the involved upper extremity after intervention (Miltner, Bauder, Sommer, Dettmers, & Taub, 1999; Taub, Uswatte, & Pidikiti, 1999). CI therapy is believed to effect reorganization of the cortex, thus producing results that are considered permanent (Taub, Crago, & Uswatte, 1998).

Unlike traditional theories and practice of motor relearning, the typical treatment protocol of CI therapy entails the wearing of a restraint on the less involved extremity. This restraint is worn for 90% of the individual's waking hours forcing the individual to use the involved side for most activities (Morris, Crago, DeLuca, Pidikiti, & Taub, 1997).

Although this treatment is not appropriate for all stroke patients, it holds great promise for 20-25% of chronically impaired individuals with some active motion (Taub, Uswatte, Pidikiti, 1999). Treatment involves exercises and activities centered primarily on fine motor movements of the impaired extremity that are not necessarily purposeful (Taub, Miller, Novack, Cook, Fleming, Nepomuceno, Connell, Crago, 1993).

Research evaluating the use of occupation-based treatment within the typical CI therapy protocol is not available. Studies that support or invalidate the effectiveness of an occupation-based constraint therapy protocol will aid therapists in choosing treatment techniques.

The purpose of this study was to evaluate the use of occupational tasks as treatment activities, within a standard CI therapy protocol. During the first pretest session, the subject was assisted in filling out an interest inventory to help the research team with the selection of treatment activities. Using an ABA design, data was collected during each of the three study phases. Motor control was assessed objectively with the Wolf Motor Function Test (WMFT) and Nine-Hole Peg Test (9HPT) and subjectively with the Motor Activity Log (MAL). Additionally, information regarding quality of movement was obtained through videotape during the administration of the WMFT.

Data were analyzed using frequency tables, parametric and non-parametric tests. Results displayed improvements in speed and quality of movement of the involved extremity during the treatment portion of the study, however, these improvements were not sustained following treatment. Furthermore, many confounding variables were present throughout the study that are thought to have negatively influenced the intended course of treatment. Based on these results, none of the hypotheses was supported.

Further investigation of occupation-based CI therapy may prove useful in the development of a successful treatment regimen for use in the occupational therapy profession.

Occupation Based

Constraint-Induced Movement Therapy

A Thesis Presented to the Faculty

of the School of Health Sciences and Human Performances

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In Partial Fulfillment of the

Requirements for the Degree

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by

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CERTIFICATE OF APPROVAL

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CHAPTER I: INTRODUCTION

Background

Cerebrovascular accidents (strokes) are the leading cause of disability, and the third leading killer in the United States, affecting approximately 600,000 people annually (Stroke Association, 1999). A stroke may create deficits in areas such as motor control, sensation, perception, and cognition. Decreased motor control on one side of the body, known as hemiparesis, is a major disabling feature for many stroke victims. The onset of hemiparesis following a stroke compromises the patient's ability to use his or her extremity. Following the initial accident, the patient will often show increased ability to move the involved extremity within the first few months after a stroke (Ryerson, 1995). As the patient continues to adapt to his/her condition over time, the degree of disability may decrease, stay the same or actually increase secondary to a phenomenon known as learned nonuse (Taub & Wolf, 1997). This phenomenon occurs when an abnormal movement pattern is reinforced or when the individual learns to complete tasks with the uninvolved extremity.

In stroke patients who exhibit hemiparesis, the ability to function successfully using only the uninvolved extremity serves as positive reinforcement to continue to use that extremity, and not use the involved extremity in the task. Simultaneously, the failed attempts or decreased success with the involved upper extremity may serve as negative reinforcement, producing decreased use of that extremity. Successful use of the uninvolved extremity combined with disuse of the involved extremity may produce an increase in the degree of disability. Physical changes such as muscle

atrophy and contractures may develop as a result of disuse of the involved extremity, which may further impede functional use of the involved extremity.

Overcoming learned non-use has been the target of a new and rigorous form of motor remediation termed Constraint-Induced Movement therapy (CI therapy). CI therapy is the name given to a treatment technique that has been shown to effectively increase the amount of use of the more involved upper extremity after a duration of intervention. CI therapy is provided between six and eight hours per day, for between ten and fourteen consecutive days. Furthermore, a restraint is worn on the less involved extremity, forcing the participant to complete most daily activities with his or her more involved side.

This is in contrast with traditional theories of motor remediation such as Neurodevelopmental Treatment (NDT), Proprioceptive Neuromuscular Facilitation (PNF) and Brunnstrom's Movement Therapy that do not restrain either extremity or provide a structured temporal protocol for treatment. Additionally, these traditional theories guide treatment sessions that are more "hands on", where the therapist uses him/herself as a therapeutic tool. CI therapy, however, does not incorporate the use of the therapist to assist the client in motor relearning through guided movements of the involved extremity.

The unique characteristics of CI treatment appear to produce a permanent improvement in the actual amount of use of the involved upper extremity. The permanence of results following treatment has been demonstrated to be a result of cortical reorganization (Taub et al., 1998). It has been found that the cortical representation of hand muscles nearly doubled in a stroke patient after receiving CI

therapy, supporting the theory of cortical reorganization. (Taub, Crago, Uswatte, 1998). This reorganization is the focus of CI therapy and appears to be the underlying factor that creates permanent results.

Statement of Research Problem

Constraint Induced Movement Therapy is a relatively new approach for motor remediation. Studies suggest that CI therapy can increase the amount of use of the involved extremity in real life activities. Though these findings are promising, limited research is available, especially from the occupational therapy perspective. Original studies utilized repetition of fine motor activities that were not necessarily meaningful to the subjects. The effects of developing treatment sessions around the subject's interests have not yet been researched. Additional studies are necessary to determine the effects of occupation-based CI therapy within the chronic stroke population.

Significance of Study

CI therapy appears to be an effective form of treatment for specific individuals within the chronic stroke population. The data from the available studies have been produced from perspectives such as behavioral neurology and clinical psychology. Additionally and generally speaking, the same research team has carried out the majority of the studies. A very small number of studies have been performed from the occupational therapy perspective, which involves the inclusion of purposeful activity in the treatment protocol. The introduction of meaningful activities into the CI therapy protocol must be researched to determine if similar results can be achieved. Determining the effectiveness of CI therapy with occupation-based treatment would

provide information necessary to support the use of CI therapy as treatment in the occupational therapy field.

The Purpose of This Study

The purpose of this study was to analyze how the use of occupation-based CI therapy affected the recovery of functional motor control with a chronic stroke patient demonstrating upper extremity hemiparesis.

Basic Definitions of Terms

Associated Reactions. "Involuntary movements or patterned, reflexive increases in muscle tone and limb position on the hemiplegic side" (Trombly, 1995, p. 434)

Chronic Stroke. For the purpose of this study, chronicicity is at least one year since the occurrence of the stroke. The underlying rationale for this definition is that most recovery following a stroke occurs within the first six to twelve months of the accident. The chronic stroke population is being studied to reduce the potential effect of natural recovery.

Constraint-induced movement therapy. CI therapy is the name given to a treatment protocol used to decrease learned nonuse and improve the quality and quantity of movement of an extremity affected by a stroke. CI therapy involves the use of a restraint on the uninvolved extremity while engaging the person in fine and gross motor activities using his or her involved extremity. CI therapy is typically provided six to eight hours per day for between 10 and 14 consecutive days.

Disability. "Any restriction or lack of ability to perform an activity in a manner or within the range considered normal for a human being" (Trombly, 1995, p.16).

Hemiparesis. Hemiparesis is "Weakness on one side of the body caused by brain damage." (Woodson, 1989, p.678).

Involved Extremity. The arm affected most significantly by the stroke, and the arm targeted to improve during CI therapy.

Occupation-based Treatment. For this study, the term occupation is being defined as any purposeful activity that is meaningful to the subject. Using the information gathered from the Leisure Occupations Interest Inventory, treatment sessions will be developed based on the interests of the subject while still targeting the use of the involved upper extremity.

Reflex. "An involuntary, stereotyped response to a particular stimulus" (Mathiowetz & Haugen, 1995, p. 170)

Stroke. "A variety of disorders characterized by the sudden onset of neurologic deficits brought about by vascular injury to the brain" (Woodson, 1995, p.677).

Tone. Defined by Stolov as "...the resistance of a muscle to passive elongation or stretching (Trombly, 1995).

Uninvolved Extremity. The arm least affected or unaffected by the stroke, and the arm which will be restrained during CI therapy.

Limitations

This study did not include a large number of participants, and as a result random sampling was not possible. Since only one participant engaged in this study, a single subject design was used to test the hypotheses. As a result, it is not expected that the data gathered will necessarily generalize to the entire stroke population. Further, the statistical analysis of data is of variable usefulness since only one subject

participated. Last, the scope of this research study did not allow for long-term treatment effects.

Assumptions

It was assumed that the assessment tools used in this study measured the variables that they claimed to measure. Additionally, it was assumed that the participating subject would adhere to the treatment protocol as designed for this study to the best of his ability. In regard to the time spent outside of actual treatment, it was expected that the subject's family and the nursing home staff where the subject resided would assist in implementing the restraint wearing protocol.

Hypotheses

The subject will demonstrate increased functional use of the involved extremity while engaging in everyday activities after completing a two-week course of occupation-based constraint induced movement therapy. The subject will also show improvements in quality and speed of movement of the involved extremity.

CHAPTER II: THE LITERATURE REVIEW

Background

Cerebrovascular accident (CVA) or stroke is the most common cause of disability in the adult population, and the third leading cause of death in the United States (Stroke Association, 1999; Woodson, 1989). Stroke is the term given to neurologic damage caused by a variety of disorders that prevent adequate blood flow to the brain. As a result of a stroke, the part of the body controlled by the area of the brain that was damaged becomes affected. Intense therapy is administered to stroke patients for the purposes of decreasing the resultant level of disability. Therapists commonly use models such as Neurodevelopmental Treatment (NDT), Proprioceptive Neuromuscular Facilitation (PNF) and Brunnstrom's model to remediate motor losses secondary to the stroke. However, little is known about the effectiveness of these models (Woodson, 1995). CI therapy is a technique that is gaining recognition among health professionals due to promising results from the initial research that suggests it is effective in achieving a return of functional motor control. The increased interest in this therapy has stimulated further research. Results from these studies show a promising future, though further evaluation of this treatment technique is needed (Miltner et al., 1999; Kunkel, Kopp, Muller, Villringer, Villringer, Taub, Flor, 1999; Taub et al., 1993).

Characteristics of Stroke

Stroke is the common term used to describe a variety of conditions that produce vascular damage in the brain. Risk factors for stroke include advanced age, hypertension, history of cardiac disease, atherosclerosis, diabetes, and history of

previous stroke (Woodson, 1995). Stroke can be subdivided into three types, and further classified by location. Thrombosis, the most common type, accounting for nearly 60% of strokes, occurs when a blood vessel in the brain becomes occluded (Ryerson, 1995). The occlusion is the result of a gradual thickening of the vessel wall.

Embolic, the second type of stroke, accounts for roughly 30% and results from a particle traveling into the brain and becoming lodged, thereby preventing adequate blood flow (Woodson, 1995). In each of these cases the vessel blockage prevents blood flow of oxygen from reaching the cells of the brain, producing brain damage.

The third and least common type of stroke, accounting for an estimated 10% of cases is termed hemorrhagic (Woodson, 1995). Hemorrhagic strokes occur when a vessel in the brain releases blood into the surrounding space. This bleeding causes an increase in pressure among the brain cells. Although only a small percentage of strokes are hemorrhagic, strokes of this nature can be very serious. Hemorrhagic strokes may occur without warning and initial mortality is high (Woodson, 1989).

Brain tissue is highly vascular, demanding a large quantity of oxygen at a regular rate. Damage from CVA results when brain tissue is not supplied with an adequate amount of oxygen. The part of the body controlled by the damaged area of the brain will ultimately be affected. Paralysis or weakness on one side of the body may occur when the stroke takes place in the motor cortex of the brain. Based on the severity of the stroke and the location of the lesion, a person may exhibit hemiplegia or hemiparesis, and other disorders of speech, perception, sensation, and/or cognition. Hemiplegia results when the brain damage is severe enough to produce complete

paralysis on one side of the body. Hemiparesis is less severe and can be described as partial paralysis or weakness on one side of the body. These signs are often the most obvious effects of a stroke since gross and fine motor movements may become disrupted (Ryerson, 1995).

Persons who suffer a stroke may initially demonstrate increased or decreased tone in the involved limb. The severity of the change in tone may initially be a result of cerebral swelling caused by the stroke (Ryerson, 1995). As the brain heals and the swelling subsides, some recovery of movement is achieved. Through the recovery phase, the stroke patient typically moves from low tone or flaccidity to high tone or spasticity. Spasticity is defined as "A state of excess tone and hyperactive response to stretch" (Trombly, 1995 p. 435). This change in tone on the involved side of the body will negatively affect the stroke patient's ability to move normally. The extent of long-term recovery depends on many variables. Though complete recovery is rare, research suggests that the recovery process continues for months and sometimes years (Ryerson, 1995). Disability arises when a stroke patient is unable to successfully participate in daily activities such as feeding, bathing or dressing, frequently due to the individual's inability to use the involved extremity to assist in these daily tasks efficiently.

Traditional Occupational Therapy Treatment of Stroke

Occupational and physical therapists typically use a two-prong approach when treating stroke patients. Immediately following a stroke, occupational and physical therapists focus on treatment to help patients regain lost motor function. Once it has been determined that a patient will not regain further movement, the treatment

approach changes, and therapy is provided to assist the subject in adapting to the disability, thus decreasing the effects of residual motor impairments (Trombly, 1995).

Theoretical frameworks and models of practice have been developed that encompass both approaches. These models help explain why disability occurs, and how a therapist can construct a treatment program that will yield beneficial results for the subject. NDT, PNF and Brunnstrom's movement therapy are motor remediation models of practice that are used to help the client regain lost movement. These models assist therapists by structuring the evaluation process and providing specific treatment techniques to use with the stroke patient exhibiting hemiparesis.

Neurodevelopmental Treatment, also known as the Bobath Approach, is a theoretical model commonly used in the remediation of motor control. The traditional NDT framework views the systems of a person in a hierarchical sequence where the higher levels of the nervous system control the lower levels (Woodson, 1989). Damage to higher levels of the brain will produce a change in the lower level systems in the body. Treatment that is structured to change higher levels of the nervous system will ultimately have an affect on the corresponding parts of the body.

Recently, NDT practitioners have taken an approach that views the person in an increasingly heterarchical sequence where lower level systems are not controlled by higher ones. In NDT treatment, a change in tone may be present following a stroke that must be normalized to produce functional movement. The client is engaged in therapy to learn how normal movement patterns feel, in order to later reproduce normal movement themselves (Trombly, 1995). The therapist uses tactile input as well as guided movement to stimulate the neuronal pathways of the involved

limb. Functional activities are engaged in by the patient in treatment that incorporates the use of both sides of the body. When treating with NDT, emphasis is placed on incorporating use of the involved side of the body in activities in a symmetrical pattern so that the patient learns how normal movement feels with both extremities (Woodson, 1989).

The NDT model provides an extensive framework for therapists to follow in regards to both evaluation and treatment. A therapist must attend a three-week training course to become certified in NDT evaluation and treatment, in order to be acknowledged as proficient in this approach (NDTA, 2001). Minimal information is known about the effectiveness of this treatment technique.

Proprioceptive Neuromuscular Facilitation is another approach used in the remediation of motor control. PNF theory includes the assumption that normal movement develops in a proximal-distal and cervical-caudal sequence (Pope-Davis, 1996). That is, a person develops movement in the head and neck before legs and feet, and shoulders before arms and hands. PNF theorists also postulate that reflexes reinforce development of more mature movement patterns. These mature movements exist basically as combinations of diagonal patterns. Guiding a person through these diagonal patterns is believed to aid in the recovery of motor control by following the normal sequence of movement (Pope-Davis, 1996; Woodson, 1989). PNF uses visual and tactile inputs to assist in motor relearning. Similar to CI therapy, repetition is important, however, PNF emphasizes becoming proficient in part of a task before the entire task is attempted. Additionally, techniques are used to facilitate or inhibit muscle groups during PNF treatment (Pope-Davis, 1996).

Brunnstrom's movement theory is a third model for motor remediation following neurological damage such as a stroke. Brunnstrom believes that motor relearning is developmental in nature and progresses through stages from reflexes to purposeful movement; and also that this progression is a result of the development of higher centers in the brain (Trombly, 1995). Unlike NDT and PNF, associated reactions and reflexes may be used to facilitate movement in the involved extremity early in treatment. Other models attempt to inhibit these reactions before functional movement is attempted. If a client demonstrates no active movement, associated reactions and reflexes are used to elicit some movement. Once some volitional movement is achieved, the use of the reflexes and associated reactions are eliminated and emphasis is placed on the active motion. Synergistic movement patterns may then be used to assist in guiding movement, however, this technique is phased out as active movement increases (Pedretti, 1996; Trombly, 1995).

Other Considerations

Depending on the setting, individual treatments guided by traditional theories typically last between 30 and 60 minutes per day. Even if a patient receives therapy daily, the amount of time spent in the clinic is relatively small compared to the time out of the clinic. Although carryover is emphasized, the motor behaviors a patient demonstrates in the clinic are often not consistent with the behaviors that they actually do in their own environment (Andrews & Stewart, 1979). This may be due to the small amount of time actually spent in treatment. Since a patient is only in treatment for a limited time, he or she may not learn new patterns sufficiently to make the transition to home. Once the patient leaves therapy, the practiced exercises may

not be carried over to real life activities because of awkwardness, inefficiency or ineffectiveness of the practiced movement. Even when the patient may have sufficiently learned these motor behaviors, he or she may not use them outside of therapy (Andrews & Stewart, 1979).

Since there are few research studies demonstrating the effectiveness of traditional theories such as NDT, PNF, and Brunnstrom's model, therapists may guide treatment sessions without fully understanding the underlying principles or effectiveness of the techniques (Woodson, 1995). Knowledge of traditional theories is known mostly through experience and word of mouth among clinicians. In the past, this knowledge was sufficient to guide treatment since practicing clinicians did not emphasize research on the effectiveness of specific treatments. Current treatment, however, must be based on research and increased scientific data supporting the effectiveness of specific treatment techniques since consumers, reimbursement agencies and patients are demanding this information.

CI Theory

CI therapy is a treatment technique used to overcome the phenomenon of learned nonuse that may occur in stroke patients demonstrating hemiparesis (Taub & Wolf, 1997). Typically, people without impairments perform many tasks bi-manually. The person with hemiparesis may learn to be more efficient in activities using only the uninvolved extremity. The increased effectiveness and efficiency of movement in the uninvolved side may serve as reinforcement to continue to use that extremity alone. With this reinforcement, the patient is learning to avoid the use of the involved extremity (Ostendorf & Wolf, 1981). This phenomenon, known as

learned non-use, may occur in patients following neurological damage such as stroke, which may result in the decreased ability to use one's less functional extremity.

Learned non-use may develop when a patient attempts to engage in a familiar activity with the involved extremity and does not feel successful. This attempt results in uncoordinated or awkward movement patterns less efficient than those using the uninvolved extremity. The inefficient movement and possibly failed attempt provides feedback that reinforces disuse of the involved extremity (Morris et al., 1997). Meanwhile, successful attempts made with the noninvolved extremity provide positive reinforcement and strengthen these effective patterns. The person begins to suppress motor attempts with the involved extremity even though he or she may be physically capable of using it during activities. The result is learned nonuse of the involved extremity (Taub & Wolf, 1997).

CI therapy attempts to overcome the phenomenon of learned non-use by increasing the person's motivation to use the involved extremity. In highly structured research studies, CI therapy has been shown to increase the actual amount of use of the involved extremity in real life activities (Thompson, 1999; Miltner, Bauder, Sommer, Dettmers, Taub, 1999; Kunkel et al., 1999). Further, CI therapy may produce an increase in fine motor ability and decrease extraneous movement patterns (Ostendorf & Wolf, 1981). This increase in motor ability is thought to be the result of cortical re-organization that is dependant upon the mass practice of the corresponding motor groups during therapy (Taub et al., 1998). Cortical reorganization is the term used to refer to two mechanisms (collateral sprouting and unmasking of neuronal

pathways) of change that the brain may undergo that result in improvement in movement in the involved extremity (Woodson, 1995).

CI therapy consists of clinic-based treatment lasting between six and eight hours per day for approximately two weeks (Morris et al., 1997). Clients are fitted with a device that restrains their uninvolved side thereby forcing the involved side to complete activities. Typically, the extremity is placed in a resting hand splint and further restrained by a sling, closed on both ends (see figure 1). This unique aspect and defining characteristic of CI therapy may cause concern about the client's safety with balance. Given this, most studies have defined prerequisite skills needed to safely participate in CI therapy including adequate balance reactions. If needed, alternate methods of restraint may be used that do not compromise the safety of the client. One method is through the use of a half-glove. Fitting a client with a glove instead of a splint and sling has been used, producing similar results (Taub & Wolf, 1997). The use of a glove decreases the safety hazards by allowing for functional use of that extremity in the event of a loss of balance.

Massed practice (6-8 hours per day) is essential for creating a transfer of function into real life activities (Taub & Wolf, 1997). Animal studies have shown that after unilateral somatosensory deafferentation (preventing a monkey from having sensation on one extremity by ceasing nerve impulses from the limb to the brain) of a monkey's limb, it will not use that limb in a free environment. Although no motor neurons are disrupted, this produces the phenomenon of learned non-use since the monkeys stop using one side of their bodies. When CI therapy is applied for two or three days the monkey will use the involved extremity. Once the restraint is removed

Figure 1

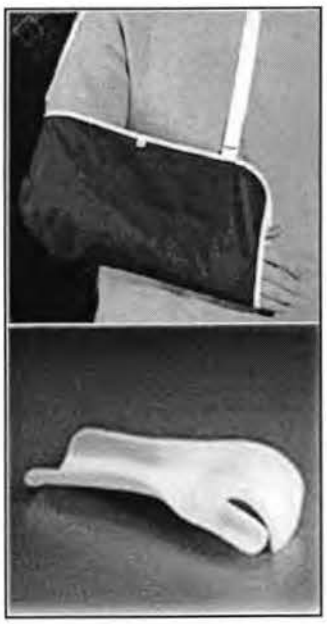


Figure 1. Top: Standard sling. Bottom: Resting Hand Splint.

Arm Sling http://www.starmedsys.com/catalog/arm.html

Splint http://www.biodex.com/dir30/914021.htm

however, the monkey will revert back to using the uninvolved extremity (Taub et al., 1999). However, if the restraint is applied for two or three weeks, the monkey will continue to use the involved extremity once the restraint is removed (Taub et al., 1999). This example demonstrates a transfer of functional use, and decrease in learned nonuse of the involved extremity as a result of the CI therapy.

CI Therapy Research

Using Magnetic Resonance Imaging (MRI) to map out the cortical representation in the brain provides valuable information about the effects of treatment. Studies that use this technique to measure change create scientific data that can be further used to develop motor remediation theories. Studies have demonstrated the plasticity of the brain and its ability for reorganization following injury (Elbert, Birbaumer, Knecht, Hampson, Larbig, Taub, 1994). Research done using Transcranial Magnetic Stimulation (TMS) suggests that the size of the cortex responsible for a particular movement is largely dependent upon the frequency in which that movement is engaged (Taub et al., 1998). In a study of cortical representation, it was found that the cortical area representing specific hand muscles nearly doubled from pretreatment to post treatment as a result of CI therapy (Taub et al., 1998). These results demonstrate that this form of treatment can effectively change higher levels of motor control. The objective of CI therapy is to produce an increase in skill transfer to real life activities that is considered permanent, as a result of cortical reorganization.

In 1981, Ostendorf and Wolf carried out a single case, ABA design research study. The purpose of this study was to measure the effect that forced use had on

quality, quantity, and efficiency of functional behaviors on the hemiparetic extremity (Ostendorf & Wolf, 1981). The subject was a 50-year-old woman with right hemiplegia as a result of a CVA 18 months earlier. Wrist extension and finger flexion and extension were intact, however movements were dominated by synergistic patterns.

Each of the three phases (pretest, treatment and, posttest) lasted seven days for a total of three weeks. During the B phase, the client's intact extremity was restrained. The client was asked to complete tasks requiring movement at all joints of the involved extremity. The time to complete these tasks was recorded. The quality of movement was rated using a numerical scale of 0 to 5 (0=no visible movement; 5=isolated movement, but weak or uncoordinated). The client was also videotaped for later review of quality of movement. These tasks represented the initial form of the Wolf Motor Function Test (WMFT) and consisted of many of the same motor tasks. She was asked to keep a self-report to track behaviors in which she engaged to measure emotional responses.

The time to complete the observed tasks generally decreased from session to session with only one exception. Quality of movement showed little change from the assessments however some decrease in extraneous movements was noted. The client's self-report showed an increase in desired behaviors in the B phase. These behaviors consisted of activities of daily living (ADL)-type tasks such as eating with fingers, combing hair and brushing teeth (Ostendorf & Wolf, 1981). Additionally, the client reported an increase in functional use of her right hand.

The results suggested that practice alone may have affected the results more than the restraint did. The study was not conclusive regarding learned-nonuse and the effect of overcoming this phenomenon with forced use. The use of the restraint for only one-week may have been too short of a period for adequate data to be gathered. Additionally, forced use for only a one week period may not have been sufficient for cortical reorganization to be achieved.

Eight years after this study, Wolf and colleagues designed a larger study to determine if forced use can reverse the effect of learned non-use (Wolf, Lecraw, Barton, & Jann, 1989). Twenty-five subjects were recruited, all exhibiting hemiplegia as a result of either TBI or CVA. Participating subjects kept their intact hand within an enclosed restraint during waking hours, for a two-week period. Subjects were evaluated on 21 functional tasks such as folding a towel, lifting a paper clip and writing their name on a piece of paper. Speed and force of movement were measured for each task. Additionally, the subjects were videotaped for analysis of quality of movement. The clinicians responsible for video analysis were instructed to evaluate movement based on synergistic or isolated movement patterns.

Following treatment and at a one-year follow up, changes were seen in speed and force in 19 of the 21 tasks that were evaluated (Wolf et al., 1989). Based on video analysis, quality of movement did not change significantly. This study supports the assumption that learned non-use does occur in some humans and that CI therapy can be used to overcome it.

In 1993, Taub et al. published results of a study that compared a group who received CI therapy, to a non-restraint group who received general therapy (Taub et

al., 1993). Subjects who met the inclusionary criteria for the restraint group were fitted with a resting hand splint and a sling. Participants were instructed to wear the sling and splint during all waking hours for the 14-day treatment period, except for certain specific activities (sleeping, toileting, and balance compromising situations). Subjects received six hours of therapy daily for ten of the 14 days. Participants in this group were given activities that were to be completed with the hemiparetic arm such as eating, checkers, card games, and pushing a broom.

The control group was divided into three subgroups. The goal for each subgroup was to increase the attention on the hemiparetic extremity. Subjects in subgroup A were told that they had greater control in their involved extremity than was being displayed. Participants in this group were encouraged to use their hemiparetic arm at home as much as possible. Subjects in subgroup B received two sessions labeled "physical therapy". Active movements were not incorporated into treatment sessions with participants in this subgroup. Instead, the therapist assessed muscle tone, joint play and sensation loss and guided the patients through passive range of motion. Subgroup C participants were instructed in self-range of motion activities to be carried out 15 minutes per day. No active movement of the involved limb was to be practiced outside of the treatment sessions.

The Emory Motor Function Test, The Arm Motor Activity Test and the Motor Activity Log were used to measure movement of the involved extremity. Additional information was provided through analysis of video for quality of movement.

Results from this study demonstrated an increase in speed and performance in the constraint group. Furthermore, quality of movement significantly improved when compared with the control group. The Motor Activity Log revealed that subjects in the experimental group experienced an increased ability to use their involved extremity in common daily tasks. Participants in the control groups improved slightly in motor function, however this was lost after a one-month period. Improvements observed in the experimental group were maintained over a two-year follow up.

Occupation-Based Studies

In 1997, a single case study was published from the occupational therapy field. An ABA design was used to evaluate the effectiveness of CI therapy in increasing spontaneous use of the more involved extremity of a child with cerebral palsy (Crocker, MacKay-Lyons, & McDonnell, 1997). Using the existing protocol was not possible since the subject in this study was a 2-year-old child. Fortunately, the child accepted the restraint and appeared to enjoy wearing the resting hand splint (Crocker et al., 1997). Data were collected over a seven-week period. The study's timeline grossly followed previous studies; two weeks of pre-testing, three weeks of restraint use, and two weeks of post-testing. Additionally, a six-month follow up was conducted. Videotape was used to measure frequency of particular behaviors during the splint-wearing phase. The Peabody Developmental Fine Motor Scale was completed during each phase to assess movement in the involved extremity. Finally, a daily log was kept by the parents during a daily feeding task. This log measured how many pieces of finger food (with a maximum of 10 pieces) the child ate in a five-minute period with her involved extremity.

The results show significant improvements in grasp and release, sensory exploration, and push and pull (Crocker et al., 1997). Video analysis revealed the subject averaged 20 pre-defined behaviors during the pre-test, 48 during the splinting phase, 38 during the post-testing phase, and 50 at the six month follow up. This net increase in particular behaviors demonstrates an increase in spontaneous use of the involved extremity. The daily log revealed that the subject did not use her involved extremity to feed herself at any time during the study. Results from the Peabody generally support the finding from the video analysis. The subjects score increased by nine points from pre-testing to splinting phase and by 17 points from the splinting phase to the post-testing phase. Scores however decreased at the six month follow up. These results suggest that restraint of the less involved extremity can increase frequency of use the more involved extremity.

Very few studies conducted with CI therapy use a truly occupation based treatment protocol. Kielhofner states, "Having a specific occupation to perform recruits and organizes behavior. Without occupations that specify what it is that the human being is accomplishing, musculoskeletal, neurological, and mental components don not get coupled together into organized patterns" (p. 81). If Kielhofner's statements are correct about the use of occupation, it would only seem logical that the use of occupation in a standard CI therapy protocol would produce similar or greater results than non-occupation based treatment.

The techniques and protocols used with CI therapy represent a relatively new treatment approach when compared to other models. Because of the recent interest in CI therapy as a new technique, research has been conducted to determine its

effectiveness. This research has produced data suggesting not only that CI therapy is an effective form of treatment to remediate motor control, but also that the results carry over to real life situations permanently (Taub & Wolf, 1997). The permanence of results in some studies has been attributed to cortical reorganization that takes place during the rigorous treatment as demonstrated through brain imaging techniques (Taub et al., 1999)

Description of Basic Procedures used in Previous Studies

Determining criteria for subject selection, choosing an assessment battery, and designing the treatment are aspects of CI therapy that need to be decided on by the entire team. No universal procedure exists for structuring CI therapy, however Morris and associates (1997) published a paper describing the protocol utilized by their research team. Discussed below are the basic procedures involved when applying CI therapy to the chronic stroke population.

CI Therapy Subject Characteristics

Studies have shown an increase of motor control and/or carryover of improvements to real life situations following CI therapy with clients who demonstrate the minimum motor criteria of extension in the involved wrist and fingers (Wolf et al., 1989; Taub et al., 1993; Blanton & Wolf, 1999; Crocker et al., 1997). If the part of the brain responsible for a given movement is completely destroyed, no recovery of that movement is possible (Taub et al., 1993). Based on this knowledge, CI therapy is appropriate for some but not all people who have had a stroke. Although inclusionary/exclusionary criteria change slightly among the studies, the required active range of motion present in the client's involved extremity

remains fairly constant. The minimum motor criteria are 10° active finger extension and 20° active wrist extension for subject selection. It is estimated that only 20-25% of the stroke population meet this criteria, thus limiting the potential treatment population (Taub et al., 1999).

In a recent study, the expansion of the motor criteria increased the eligibility of stroke patients to nearly 50% of the stroke population (Crago, Yakely, DeLuca, Allen, Shaw, Pidikiti, Taub, 2000). The inclusionary criteria in this study required subjects to be able to extend their wrist, thumb and at least two additional fingers at least 10°. Decreasing the specified amount of movement broadened the criteria. Subjects, however, are still required to demonstrate some active extension. Limited research has been conducted with motorically lower functioning clients, and it appears promising that CI therapy may be beneficial to this population (Crago et al., 2000). Though the motor criteria may be different, the requirement that a person demonstrates decreased (but not absent) movement in the involved extremity remains constant.

Since the client is expected to wear the sling and splint outside of clinic, he or she must demonstrate sufficient balance to minimize possible physical harm from falling with inadequate equilibrium reactions. If wearing a restraint poses a possible threat to safety, a half glove can be worn instead of the restraint that enables the subject to use the uninvolved extremity if needed. Balance must be assessed with either standardized assessment or skilled observation.

Although CI therapy may be beneficial for cognitively lower functioning clients, the participant should be cognitively intact to understand and cooperate with

the restraint guidelines. The Mini-Mental Status Exam (MMSE) is one cognitive evaluation that may be administered in the subject selection stage to determine if the subject will benefit from this type of therapy. Minimum scores on the MMSE of 19 and 26 have been used to ensure that the subjects were cognitively intact to cooperate with the treatment protocol and understand the purpose of the treatment (Kunkel et al., 1999). Perceptual screenings were not discussed in the literature, and therefore it is not known if participating subjects experienced issues of neglect or visual field loss.

Assessments used in Previous Studies

Assessment tools must be chosen which measure the appropriate variables. A number of assessments are available which assess motor function such as active range of motion and dexterity. Fewer tools are available that look at transfer of function from a clinic setting to real-life settings outside of therapy. Since it has been determined that how a client functions in his or her own environment may be different than behavior exhibited in the clinic, a tool that measures this difference may be necessary.

In the protocol for treatment presented by Morris et al. (1997), several possible assessments used to measure change in function are recommended; these include the Actual Amount of Use Test (AAUT), Wolf Motor Function Test (WMFT) and the Motor Activity Log (MAL). These assessments have been developed to account for the possibility that a client may demonstrate different behaviors in and out of the clinical setting. The AAUT attempts to measure quality of movement of the involved extremity in the real life situation. The WMFT is used as a pre and

posttest measure and assesses the client's ability to complete 17 different upper extremity motor tasks. These tasks are timed and video taped for rating of quality of movement.

As a structured interview, the MAL asks the client specific questions regarding 30 common daily tasks. The subject must rate him/herself using two scales; one for frequency of use and one for quality of movement. The research team that developed this tool suggests administering it approximately ten times throughout treatment (Morris et al., 1997), however administering a subjective assessment in high frequency may increase the risk of producing desired results (van der Lee, Beckerman, Lankhorst, Bouter, Blanton, Wolf, 2000).

Since the tools developed by Morris et al. (1997) are relatively new, information about reliability and validity is limited. Though the MAL is in its preliminary form, information about the WMFT has been made available. Researchers using the WMFT have demonstrated intra-class correlation coefficients ranging between .97 and .99 with excellent concurrent validity with data from the Fugl-Meyer Upper Extremity Assessment. "Correlations were -0.54 (p=0.02) at a first rating session and -0.68 (p=0.00) at a second session" (van der Lee et al., 2000, p. 3).

Other researcher teams recommend and have used different assessment tools. van der Lee et al. suggest using the Action Research Arm Test (ARAT) and the Rehabilitation Activities Profile (RAP) as the primary outcome measures because more information is available regarding their validity and reliability (van der Lee et al., 2000; van der Lee, Waganeer, Lankhorst, Vogelaar, Deville, Bouter, 1999).

The Arm Motor Ability Test (AMAT) is used to assess deficits in activities of daily living in the clinical setting (Kopp, Kunkel, Flor, Platz, Rose, Mauritz, Gresser, McCulloch, Taub, 1997). This tool was originally developed to measure the effectiveness of CI therapy. Research to determine the validity and reliability found the AMAT to demonstrate inter-rater reliability with most kappa coefficients being above .70 (Kopp et al., 1997). Furthermore, "when compared against the Motricity-Index-Arm score: the inter-test Spearman correlation coefficient was -.45 for performance time, .61 for Functional Ability, and .60 for Quality of Movement" (Kopp et al., 1997, 619). The authors state that the AMAT is internally consistent (Cronbach's alpha = .62).

Treatment

The increased concentration of treatment is perhaps the greatest distinguishing feature that sets CI therapy apart from traditional therapies. It may be argued that the use of a constraint is what makes CI therapy unique, however it is through the expanded motor practice that cortical reorganization is believed to produce the permanent results (Taub et al., 1999).

Treatment consists of activities and exercises specifically designed to facilitate movements in the involved extremity. Although these are not rigidly set tasks, activities should be developed that facilitate desired movements in the involved extremity. Scheduling activities in half-hour blocks with occasional rest breaks keeps the client from becoming bored (see figure 2). Shaping techniques may be incorporated into therapy as a behavioral training technique (Taub & Wolf, 1997). This term describes a type of clear feedback that the therapist gives to the subject

Figure 2

Name: Mr. B Date: 2/25/01

8:50 - Client arrives

9:00 – WMFT, 9HPT administered

9:20 - MAL administered

9:30 - Sling on

9:40 - Fine motor activity I

10:05 - Break/stretch

10:20 - Fine motor activity II

10:50 - Break/stretch

11:00 - Fine motor activity III

12:00 - Lunch (First half with sling on and supervision, second half with sling off)

1:00 - Sling on

1:10 - Fine/Gross motor activity I (hobby)

2:00 - Break

2:10 - Fine/gross motor activity I or II

3:00 - Break/end of day

3:00 - 10:00 - Client should wear sling ~90% of time awake

Figure 2. Example of CI therapy daily schedule used in this study.

about his or her motor performance during a task. This verbal feedback is different from other training techniques in that it provides information related to the slightest amount of improvement (Morris et al., 1997). No verbal feedback is given if the client does not improve the quality of performance.

To limit spontaneous use of the uninvolved hand, clients are fitted with a resting hand splint and sling that is to be worn for approximately 90% of their waking hours. Typically, clients are instructed not to wear the restraint while toileting, sleeping, eating, or engaging in balance-compromising activities. Formal treatment lasts between six and eight hours per day for between ten days and two weeks. Caregivers and/or significant others may be involved to maximize safety and compliance outside of the clinic (Morris et al., 1997). The majority of prior research has not included occupation-based treatment, and its effect on motor control. Crocker's study in 1997 focuses on occupation for evaluation purpose, however it does not use occupation-based treatment in a clinic setting for 6-8 hours per day. Doing so would have proven difficult since the subject was a 2-year-old child. As a result of the lack of occupation centered CI therapy, this single subject study was designed to determine its effect in the chronic stroke population.

In summary, several models of motor remediation are present to improve motor control in the hemiparetic extremity. Models such as PNF, NDT, and Brunnstrom's model are commonly used in the clinic setting. Research on these models is scarce, and little is known about their effectiveness.

CI therapy is a relatively new type of treatment to increase motor control in the hemiparetic extremity. Although this type of treatment is continuing to be analyzed, research has already supported its use to increase quality and quantity of movement in extremities of people with neurologic damage. This research however has been done primarily with treatments consisting of rote exercises that are not meaningful to the subjects.

Discussed further in the next chapter is the methodology used in this study, for incorporating occupation-based treatment into a standard CI therapy protocol.

CHAPTER III: METHODOLOGY

This study utilized a single subject ABA design to evaluate the effectiveness of occupation-based constraint-induced movement therapy to increase functional use of the involved extremity after a stroke. Three hypotheses were developed stating that the subject would demonstrate increased quality and speed of movement, and improved functional use of the involved extremity. The MAL, WMFT, and 9HPT were used to test these hypotheses. This study used an adapted replication of the protocol outlined by David Morris, Jean Crago, Stephanie DeLuca, Rama Pidikiti and Edward Taub (1997).

Participant, Sampling Criteria & Selection Method

Participants

The proposed methodology for this study included two subjects, however only one subject was recruited for participation in this study (see chapter IV for a further description of the subject). The participant presented with CVA as the primary diagnosis with resulting left hemiparesis. The subject however did not meet the chronic stroke description of one year. Instead he presented six months since the time of his stroke. The subject was free from any additional conditions or diseases that may have affected quality of movement. During the time of this study, the subject was not participating in any other experimental studies.

Sampling Criteria

This study used eligibility criteria similar to the criteria used in earlier studies by several research teams (Miltner et al., 1999; Kunkel et al., 1999; Morris et al., 1997). These criteria assist researchers by increasing the probability that participants

will benefit from this treatment. The criteria also decrease the likelihood of participant injury by grossly assessing standing and sitting balance, as well as overall safety. The participant was capable of minimal movements in wrist, thumb, and fingers. A minimum motor criterion of at least 10° metacarpal-phalangeal extension of the digits and 20° wrist extension was actively achieved by the participant.

To increase the likelihood of participant adherence outside of the clinic setting, a minimum score of 24 on the Mini-Mental State Exam (MMSE) was required prior to participation. This score was used in previous studies to indicate adequate memory and understanding to carry out home programs and comply with researcher instructions.

Selection Method

A convenience sample was used for participant selection. Assisted living centers, nursing homes and stroke support groups in Ithaca, New York were contacted for possible subjects. These facilities and support groups were given a copy of the approved human subjects proposal and informed about the study. With the assistance of the occupational therapy department at a nearby nursing home, two participants were initially recruited for this study. One of the subjects, however, was in the process of moving out of the nursing home and was not able to participate.

Once the potential participant was identified, he was contacted by the primary researcher and provided with a description of the research study (see appendix B). During the first contact meeting, the subject was given an initial assessment to determine if he met the inclusionary criteria. Once it was established that the subject was interested in the study and met the inclusionary criteria, he was informed about

the study in its entirety. The subject was asked to sign an informed consent form (see appendix B).

Measurement Instruments

Tools Used in Subject Selection

Active range of motion was measured using goniometry, on the subject's involved extremity to determine if he met the minimum motoric inclusionary criteria. The term goniometry literally means the measurement of angles; and in this case is the measurement of angles formed at joints in the body (Norkin & White, 1995). Extension of the subject's wrist, thumb and fingers were all measured prior to this study. In a clinical study of active wrist motion, intra-rater reliability was found to be greater than 0.90, and inter-rater reliability was found to be greater than 0.78 for active range and greater than 0.66 for passive range (Trombly, 1995).

The Mini-Mental State Exam (Appendix F) was administered to assess cognitive level (Folstein, Folstein, & McHugh, 1975). A minimum score of 24 was required to ensure that the subject understood the study as well as his ability to adhere to the restraint-wearing schedule outside of the treatment sessions. Test retest reliability was tested and Pearson r correlations were calculated at .88. Inter-rater reliability was found to be good, with a calculated Pearson r of .82. Last, concurrent validity was found in the verbal section to be .77, and in the performance section found to be .66 (Folstein, Folstein, & McHugh, 1975).

Balance was assessed using clinical observation. Standing balance is typically evaluated through observation and professional judgment to ensure subject safety. The subject who participated in this study, however, used a manual wheelchair as his

primary means of locomotion. For this reason, sitting balance was evaluated based on observation, instead of standing balance. Finally, the subject demonstrated safety awareness about the use of a restraint through his ability to doff the sling if needed. Additionally, he was able to judge when the restraint was uncomfortable to prevent abrasions and pressure sores on his skin.

Tools Used in Pretest and Post-test

The Leisure Occupation Interest Inventory

The Leisure Occupation Interest Inventory (LOII) is an assessment tool that was administered once during the first pretest session (Appendix G). The LOII is used to help the participant identify leisure activities (Stein & Cutler, 1998). These interests were incorporated into daily treatment activities to produce more meaningful therapy sessions. The LOII identifies 21 areas of interest providing examples in each area. Normative data is not available for the LOII. The participant was asked to rank his degree of interest in each area as high, moderate or low. This information was then used to develop specific activities to use during treatment sessions. Since interests of the subjects are being used only to develop treatment activities and are not being measured, normative data is not needed for data analysis.

The Nine-Hole Peg Test

The Nine-Hole Peg Test was developed as a quick measure of finger dexterity. The score for each hand is the time (in seconds) it takes to place nine pegs into a square, wooden board and then remove them. Normative data has been collected on 618 males and females ranging in age from 20-75+. A high inter-rater reliability (right $r = .97$. left $r = .99$) was obtained, and test-retest reliability was high

(r = .69) (Mathiowetz, Weber, Kashman, Volland, 1985). This assessment was administered during the four pretest and post-test sessions and multiple times during the treatment phase. The Nine-Hole Peg Test was chosen over similar tests because it requires less time to administer.

The Motor Activity Log

The MAL is a subjective assessment tool used to determine the client's quality of movement and amount of extremity use in 30 common daily tasks (Appendix D). Each question is specific to a different task commonly engaged in around the home. The client is asked first if he has engaged in that task; if he has, he must rate his performance and amount of use of the involved extremity in task completion. Two 6-point scales are provided for the client to rate his involved extremity (see figures 3 & 4). If he hasn't performed the task, he must choose from 5 options explaining why the task was not performed (see figure 5). The client is able to provide his own justification for not performing the task. The MAL was administered during all three phases of research; pretest, treatment, and posttest. During the pretest and posttest phases the entire assessment was administered each session. During the treatment phase, half of the assessment was administered each day. Scores obtained from the MAL were entered into frequency tables so that a trend analysis would be possible (see tables 1-30 in appendix A). Thirty tables were constructed, each representing a separate task. For each task, scores were taken from each of the four pre-treatment MAL's, every fourth treatment MAL and each of the four post-treatment MAL's. The frequency of "yes" and "no" responses were recorded.

Figure 3

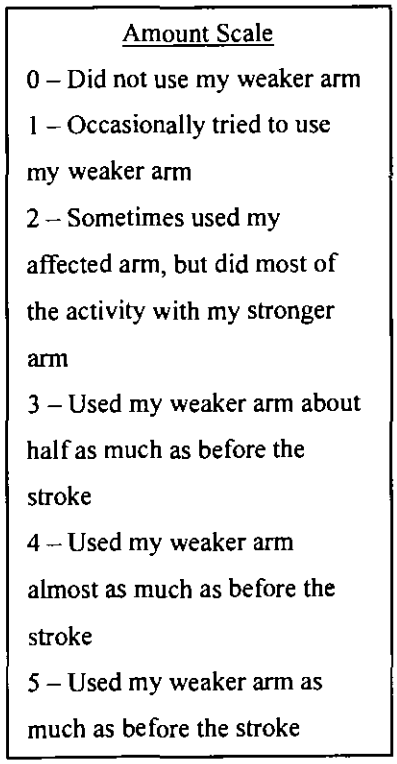


Figure 3. The MAL "Amount" Scale

Figure 4

How Well Scale

0 – The weaker arm was not used at all for the activity

1 – The weaker arm was moved during the activity, but was not very helpful

2 – The weaker arm was used during the activity, but needed some help from the stronger arm, moved very slowly, or with difficulty

3 – The weaker arm was used for the purpose indicated, but movements were slow or were made with some effort

4 – The movements made by the weaker arm were almost normal, but not quite as fast of accurate as normal

5 – The ability to use the weaker arm for that activity was as well as before the stroke

Figure 4. The MAL "How Well" Scale

Figure 5

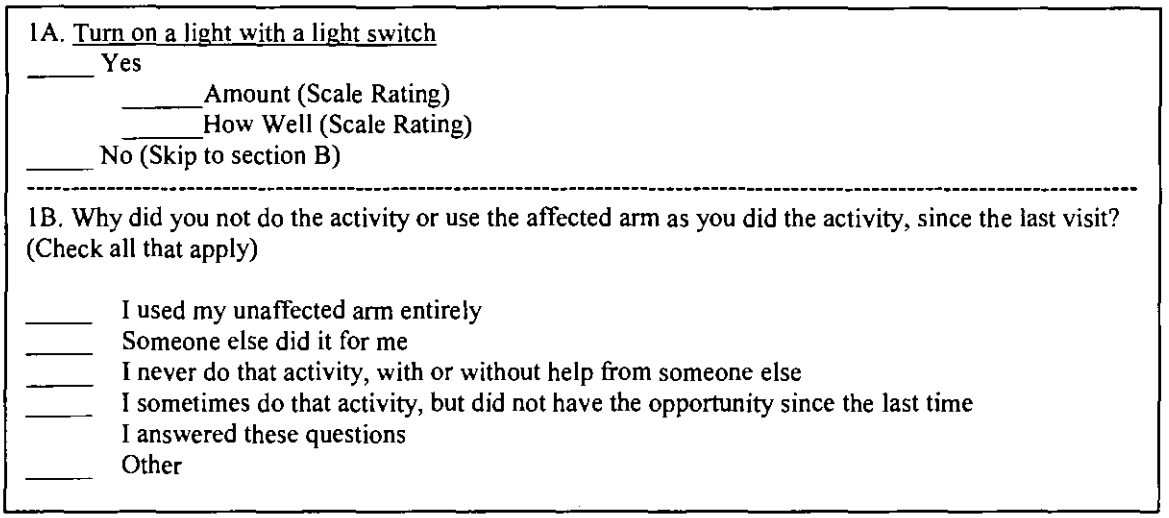


Figure 5. A sample question taken from the MAL. The subject is asked if he has engaged in the task since the last time of test administration; if he has, he must then rate himself using the "amount" and "how well" scales. If he has not engaged in the task, he must skip to part B of the question and provide a justification for not engaging in the task.

For each "yes" response, the sub-scores for "amount of use" and "how well" were recorded. For each "no" response, the options representing why the task was not completed was marked. The MAL is reported to have high internal consistency (Cronbach's α=.88-.09) high inter-rater reliability and intra-class correlation of $p<.01$ (Taub & Uswatte, 2000).

The Wolf Motor Function Test

The WMFT consists of 17 motor tasks (see figure 6) that examine movement in the upper extremity (Appendix E). Each task is given two scores. The first score is the amount of time in seconds that it takes the subject to complete the task. The second score is for quality of movement based on a six-point scale (see figure 7). In this study however, tasks 14 – 17 were omitted. Task 14 (grip strength) was not included because strength was not a dependent variable in this study. Task 15 was omitted because a lock and key mechanism was not available, and it was not part of the subject's daily routine. Task 16 was attempted during the pretest period, however was too cognitively complex for the subject to perform. This task, although possible for the client to physically complete, was affected by his decreased sequencing and problem solving ability. Task 17 was omitted secondary to the client's non-ambulatory status. He used a manual wheelchair as a result of poor balance and strength in his lower extremities. For this reason, only those tasks that are completed in the sitting position were attempted. During administration of the WMFT, a grid is taped to the table to increase standardization. This grid marks starting points for the tasks to be completed. Specific tasks were described and demonstrated to the participant three times before the participant attempted this movement.

Figure 6

Wolf Motor Function Test Tasks

1. Forearm to table (side)
2. Forearm to box (side)
3. Extend elbow (side)
4. Extend elbow (weight)
5. Hand to table (front)
6. Hand to box (front)
7. Weight to box
8. Reach and retrieve
9. Lift can
10. Lift pencil
11. Lift paper clip
12. Stack Checkers
13. Flip cards
14. Grip strength
15. Turn key in lock
16. Fold towel
17. Lift basket

Figure 6: The 17 tasks of the WMFT. Each task is video taped and timed.

Figure 7

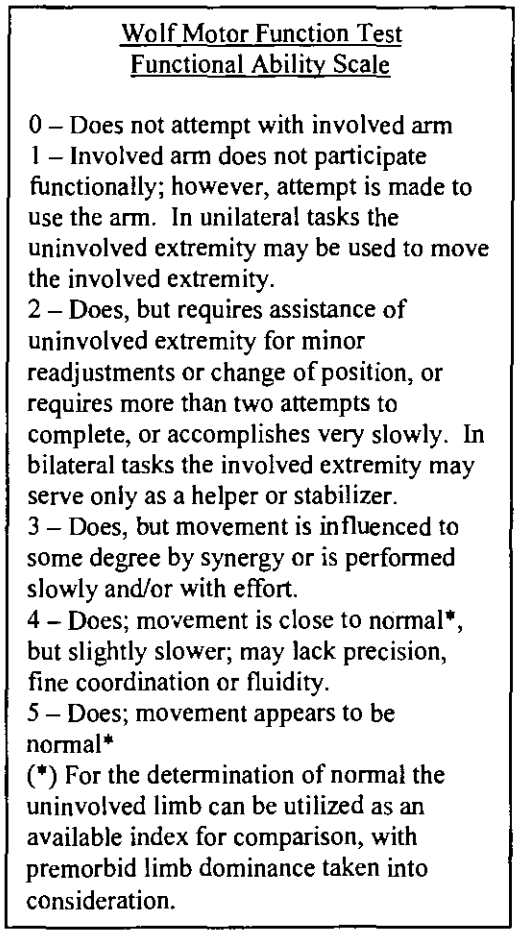


Figure 7. The WMFT Functional Ability Scale. This scale is used to rate quality of movement in each of the tasks presented in the WMFT.

All motor task attempts were videotaped for quality of movement scoring at the completion of the study. Members of the research committee, who did not work directly with the subject, completed the video analysis. The video segments were randomized and recorded onto three separate tapes. Each member of the research committee reviewed each tape, scoring all tasks in each segment. Once all members had scored the tapes, they met to discuss the scores. If a discrepancy in scores were present, an agreement was made so that only one score was present for each motor task. Scores were then submitted to the primary researcher for analysis. The WMFT has intra-class correlation coefficients ranging from .97 – .99. Additionally, concurrent validity with the Fugl-Meyer Upper Extremity Assessment Test produced a p value less than .01 (van der Lee et al., 2000).

Analysis of Data

Data were analyzed using visual graph analysis, frequency tables, parametric and non-parametric tests. Frequency tables enabled the researcher to analyze the data gathered in the MAL. The responses from each separate task for each of the three phases were displayed in frequency tables. Trends were then established visually in the subject's responses to subjective questions that measured the frequency and quality of movement in 30 common daily tasks.

Scores from the WMFT were analyzed with the Statistical Package for the Social Sciences (SPSS), using parametric and non-parametric tests. A Student T-Test was used to compare time scores for each of the thirteen tasks. Task three was excluded from parametric testing since a time score of 120 was achieved on each testing day. 120 seconds is the maximum time allowed for each task. Tasks 14 – 17

were excluded for one of a number of reasons, as stated above. T-Tests were used to find significant differences in time scores between pretreatment and treatment, treatment and post treatment, and also between pretreatment and post treatment.

Each video segment was randomized and analyzed by 3 members of the research team for quality of movement on a six-point scale. Each member who was involved in the video analysis is an occupational therapist with at least 15-years of experience in the field, and a faculty member of Ithaca College. Prior to analyzing the video, each member was instructed in the scoring procedure. Additionally, each member completed a "practice rating" and discussed the scoring criteria with the other members to increase inter-rater reliability. When rating the quality of movement from the videotape, each of the thirteen tasks was looked at for movement around a specific joint. The raters used tasks 1, 2, 5 –7 to rate shoulder movement. Tasks 3 and 4 were used to rate elbow movement. Tasks 9 – 13 were used to rate hand movement. The WMFT doesn't specify which movements or muscle groups should be observed in each task, and therefore the breakdown of movements as stated above was determined by the three members on the research committee who analyzed the videotape.

Non-parametric tests including the Kruskal-Wallis Test and the Mann-Whitney U Test were used to find significant differences in categorical scores for quality of movement of each task. The Kruskal-Wallis can be used with an indefinite number of samples and produces a p value signifying significant difference between all three phases. The Mann-Whitney U Test is a post hoc measure used to determine where the significant difference lies, once it has been determined to be significant

based on the Kruskal-Wallis Test. The Mann-Whitney Test was only used if Kruskal-Wallis p value was less than .05.

Time scores from the Nine Hole Peg Test were plotted in a line graph form for both the involved and uninvolved extremity. The three study phases were separated by lines and further labeled with the mean time score for its corresponding phase. Celeration lines were then calculated which enabled a visual trend analysis of the time score data.

Procedure

The subject was asked to participate in four pretreatment and four post treatment sessions for approximately 1.5 hours each. Additionally, the subject agreed to participate in treatment for 14 consecutive days, for six hours per day. During the pretreatment and post treatment phases, the Nine-Hole Peg Test (9HPT), The Motor Activity Log (MAL), and The Wolf Motor Function Test (WMFT) were administered. These assessments were also administered daily during the treatment phase followed by approximately six hours of treatment. During the first pretreatment session, the subject completed the Leisure Occupations Interest Inventory, which was used to develop treatment activities that were both meaningful and purposeful to the subject.

Four pretreatment sessions were arranged with the subject to establish a baseline for upper extremity function. Pretreatment assessments were conducted at the nursing home where the subject resided. These were scheduled in the afternoon following lunch. The subject was set up in a quiet part of the cafeteria with little distraction. Pretreatment evaluation lasted approximately 1.5 hours and consisted of

administration of three assessment tools and further discussion about the study. The assessments were administered in the following sequence, which remained constant throughout the study. First the nine-hole peg test was administered, followed by the first half of the MAL, followed by the WMFT, and followed by the second portion of the MAL.

During the treatment period, the subject was fitted with a restraint, consisting of an arm sling closed at both ends (see top illustration of figure 1). Treatment was scheduled to begin on Monday, February 5 at the occupational therapy clinic at Ithaca College. Transportation was arranged for the subject through a local bus company. Treatment was scheduled to begin at 9:00 in the morning and last until approximately 3:00 at which time the same transportation company would take the subject back to his home.

Prior to treatment, staff at the subject's nursing home including the physical therapist, occupational therapist and nurses were informed about the study and instructed with sling use. Additionally, the subject's family was involved in developing treatment activities and informed about the study.

Occupation-based CI therapy was provided to the subject for 16 days over a three-week period of time. Treatment was originally planned to occur at Ithaca College. This plan, however, was modified two weeks into treatment, when it became too difficult to achieve because of the subject's health and comfort level. In order to continue with the study, treatments were later scheduled to take place at the subject's nursing home. Treatment activities consisted primarily of crafts, games, and ADL tasks. Treatment lasted from approximately 9:00 am until 3:00 pm and took

place primarily at the subject's nursing home (Figure 2). Refer to appendix B for a detailed outline of treatment sessions.

Time Line

Weeks one and two represented the A phase or pretest. Pretest data gathering took place during a two-week period on the dates of January 23, 25, 30 and February 1. Phase B, the treatment phase was also scheduled to take place in a two week time period. This however did not occur as scheduled because of subject illness. Treatment dates included February 5, 12, 13, 19,20, and half day of the 21st. Treatment then continued on February 24 – March 1. March 2nd was skipped secondary to a schedule conflict. The last phase of treatment took place from March 3 – March 6. Similar to the pretest phase, phase C or post-testing took place on March 8, 13, 15 and 20.

Operationalization of Concepts Into Variables

Variables

Dependent Variables

Several dependent variables were evaluated throughout this study. First, the functional use of the hemiparetic extremity in real life activities was evaluated through the MAL, a structured interview. Quality and speed of movement of the involved extremity were evaluated using the Wolf Motor Function Test and 9HPT.

Independent Variables

Independent variables for this study included all the aspects of the CI therapy that were likely to cause change. These included treatment activities, mass practice using the involved extremity, and the use of the restraint.

Intervening or Confounding Variables

Confounding variables were present throughout the study and included the subject's health, confusion on the part of the nursing home staff, decreased adherence to the restraint-wearing schedule, and frequent rest/nap breaks needed for the subject throughout the treatment days.

Operational Definitions

Constraint-Induced Movement therapy (CI therapy) with an occupation-based focus is the name given to the treatment protocol being used in this study. CI therapy uses a restraint consisting of a sling (closed at both ends) to prevent the uninvolved extremity from participating in common daily activities. The restraint is worn for 90% of waking hours while the participant is engaged in therapy six hours per day for 14 consecutive days. Treatment consists of activities that are meaningful to the subject and includes hobbies such as woodworking, crafts, and games.

Stroke is defined as "A variety of disorders characterized by the sudden onset of neurologic deficits brought about by vascular injury to the brain" (Woodson, 1995, p.677). A common and major disabling result of a stroke is weakness on one side of the body caused by vascular damage in the brain. The subject in this study suffered a right hemispheric stroke with resultant left hemiparesis.

Chronic stroke is the primary diagnosis of the subject participating in this study. For the purpose of this study, the term "chronic stroke" is being defined as someone who has suffered a stroke at least 6 months to one year prior to receiving CI therapy. It has been determined that most recovery following a stroke takes place during the first six months to a year after the stroke (Ryerson, 1995). For this reason,

the criterion that the subject must be at least 6 months post stroke is being used to select participants who are not in the acute or sub acute stages of recovery.

CHAPTER IV: RESULTS

The Subject

The subject who participated in this study was a right hand dominant, 83-year-old man who had suffered a right hemispheric stroke 6 months earlier, resulting in left hemiparesis. The subject resided in a nursing home in Ithaca, NY and had been living there since the time of the stroke. Professionally and prior to retirement, the subject had been the head of a maintenance department at a large facility, and relied heavily on the use of his hands to earn a living. Having the ability to use his hands was important to the subject and increased his motivation to participate in the study. Following the stroke, the subject used a wheelchair as his primary means of locomotion. Most daily activities were carried out with his right hand, as reported by nursing home staff and through observation.

The participant scored a 27 out of 30 on the Mini-Mental State Exam, which met the inclusionary criteria for cognition. He further achieved or exceeded active movement in his involved upper extremity as measured with a goniometer, which met the physical inclusionary criteria.

Functional Use of the Involved Extremity

The first hypothesis in this study stated that a subject who received occupation-based CI therapy would demonstrate an increase in functional use of his involved extremity in everyday activities following the study. Data was collected using the MAL to determine if a difference in "real-life" use of the involved extremity existed at the completion of this study.

Frequency tables (see tables 1-30 in Appendix A) for the MAL show that change can be observed between all three phases; pretreatment and treatment, treatment and post treatment, and also between pretreatment and post treatment. In some instances, no change was noted in the frequency of "yes"/"no" responses, however a change in the subject's quality and amount of movement can be seen.

A comparison of responses seen between pretreatment and treatment (see table 31) reveals eleven tasks (tasks 1,2,3,4,19,20,21,25,28,29, and 30) with an increased frequency of "yes, I used my involved extremity" responses. Eight tasks (tasks 8,12,13,14,15,16,18, and 23) demonstrate a decrease in frequency of "yes, I used my involved extremity" responses. Eleven tasks reveal no change in the frequency of "yes, I used my involved extremity" responses. Of these tasks with no change in frequency of "yes" responses, six (tasks 6,7,9,17,22, and 27) maintained zero "yes, I used my involved extremity" responses and therefore amount of use and quality could not be observed to change. The remainder of tasks with equal "yes, I used my involved extremity" responses showed an increase in "how well" scale in three tasks and no change in one task.

A comparison of responses between the treatment phase and post treatment phase (see table 32) reveals that eleven tasks (tasks 2,3,5,8,9,16,18,19,21,24, and 26) increased in frequency of "yes, I used my involved extremity" responses. Four tasks (tasks 20,23,25 and 28) decreased in frequency of "yes, I used my involved extremity" responses, and fifteen tasks (tasks 4,6,7,10-15,17,22,27,28 and 30) show no change in the frequency of "yes, I used my involved extremity" responses. Of the 15 tasks that show no change in frequency of "yes, I used my involved extremity"

Table 31:
A comparison of change in responses between pretreatment and treatment

	"Yes" Responses			"How Well"		
Task	↑	↓	No Δ	↑	↓	No Δ
1	•			•		
2	•			•		
3	•			•		
‡4	•					
5			•			•
6			•			•
7			•			•
8		•		•		
9			•			•
††10			•			•
††11			•	•		
‡12		•				
‡13		•				
‡14		•				
‡15		•				
16		•		•		
†17			•			
‡18		•				
‡19	•					
‡20	•					
‡21	•					
†22			•			
23		•			•	
24			•	•		
25	•			•		
26			•	•		
†27			•			•
‡28	•					
‡29	•					
‡30	•					

‡ Not able to determine change in "how well" and "amount" secondary to lack of rating in either pre or post test phase
† Task never engaged in by subject during study
†† Task engaged in daily by subject during study
↑ Represents an increase in frequency of responses
↓ Represents a decrease in frequency of responses
No Δ Represents no change in frequency of responses

Table 32:
A comparison of change in responses between treatment and post treatment

	"Yes" Responses			"How Well"		
Task	↑	↓	No Δ	↑	↓	No Δ
1			•	•		
2	•			•		
3	•			•		
4			•		•	
‡5	•					
†6			•			•
†7			•			•
8	•				•	
‡9	•					
††10			•	•		
††11			•	•		
12			•			•
13			•			•
14			•			•
15			•			•
16	•				•	
†17			•			•
‡18	•					
19	•				•	
‡20		•				
21	•			•		
†22			•			•
‡23		•				
24	•			•		
‡25		•				
26	•				•	
†27			•			•
28			•			•
‡29		•				
30			•		•	

‡ Not able to determine change in "how well" and "amount" secondary to lack of rating in either pre or post test phase
† Task never engaged in by subject during study
†† Task engaged in daily by subject during study
↑ Represents an increase in frequency of responses
↓ Represents a decrease in frequency of responses
No Δ Represents no change in frequency of responses

responses, three tasks increased in "how well" responses, two decreased in "how well" responses and ten remained the same.

The overall change seen between a comparison between pretreatment and post treatment (see table 33) shows that thirteen tasks (tasks 1-5,8,9,19,21,24,26,28 and 30) increased in the amount of "yes, I used my involved extremity" responses. Eight tasks (tasks 12-16,18,23 and 25) decreased in the frequency of "yes, I used my involved extremity" responses, and nine tasks (6,7,10,11,17,20,22,27, and 29) showed no change in the number of "yes, I used my involved extremity" responses. Of these 9 tasks that remained the same, three tasks increased in responses of "how well" and/or "amount". The remaining six showed no change in these scores. Amount scores can only be compared between pretreatment and post treatment, as the patient is not asked to rate him/herself in amount of use during the treatment portion. Doing so would have produced skewed data since the restraint was being worn many hours per day.

Tasks that were answered with a "yes, I used my involved extremity" were then rated on the "amount" and "how well" scales. Although frequency of "yes, I used my involved extremity" responses may have decreased, the client may have scored himself higher on the two sub-scales. Additionally, tasks that showed an increase in the frequency of "yes, I used my involved extremity" responses may show

Table 33:

A comparison of change in responses between pretreatment and post treatment

	"Yes" Responses			"How Well" Responses			"Amount" Responses		
Task	↑	↓	No Δ	↑	↓	No Δ	↑	↓	No Δ
1	•			•			•		
2	•			•			•		
3	•			•			•		
‡4	•								
‡5	•								
†6			•			•			•
†7			•			•			•
8	•			•				•	
‡9	•								
††10			•	•			•		
††11			•	•			•		
‡12		•							
‡13		•							
‡14		•							
‡15		•							
16		•		•				•	
†17			•			•			•
18		•				•	•		
‡19	•								
20						•			•
‡21	•								
†22			•			•			•
‡23		•							
24	•			•				•	
‡25		•							
26	•			•			•		
†27			•			•			•
‡28	•								
29			•			•			•
‡30	•								

‡ Not able to determine change in "how well" and "amount" secondary to lack of rating in either pre or post test phase

† Task never engaged in by subject during study

†† Task engaged in daily by subject during study

↑ Represents an increase in frequency of responses

↓ Represents a decrease in frequency of responses

No Δ Represents no change in frequency of responses

a decrease in the "amount" and "how well" scale. The frequency tables should be consulted to note the change in these scores.

Tasks 6,7,17,22 and 27 were never completed during the course of this study and maintained zero "yes, I used my involved extremity" responses for each phase. In contrast, tasks 10 and 11 were engaged in daily and answered with a "yes, I used my involved extremity" consistently. Again, the frequency tables should be referred to for changes in "amount" and "how well".

Based on wide range of results from the MAL, the first hypothesis was not supported.

Speed and Quality of Movement of the Involved Extremity

The remaining two hypotheses were tested using the WMFT and 9HPT. These hypotheses stated that a subject who participates in this study would show an increase in quality of movement while engaging in a predetermined motor task (see figure 6), and that the time it would take to complete that task would decrease.

Using the WMFT, two sets of scores were recorded using this assessment to determine if the above hypotheses would be achieved. Significant differences were observed in tasks 1, 7, and 11 for either time or categorical scores (see tables 34 – 38). No statistical significant differences were seen in other tasks.

Change in quality of movement score for task 1(forearm to table, side) was found to be significant ($\chi^2 = 8.908$,df = (2), $p = .012$) using the Kruskal-Wallis Test with an alpha < .05. The Mann-Whitney Test reveals that significance for task 1 lies between pretreatment and treatment ($U = 4.0$, $z = -2.877$, $p = .004$) and pretreatment and post treatment ($U = 2.0$, $z = -2.049$, $p = .004$).

Table 34
Student T-Test Comparing WMFT Time Scores Between Pretreatment and Treatment

Task	T	df	p
1	1.275	3.498	.28
2	0.167	3.537	.877
3[1]			
4	0.025	4.782	.981
5	-0.098	9.148	.924
6	-0.918	11.541	.378
7	-1.398	11.014	.189
8	-1.125	11.022	.285
9	1.936	3.790	.129
10	0.365	4.108	.733
11	-3.459	13.387	.004
12	-1.223	11.031	.247
13	-0.434	13.005	.672

[1]Data not statistically analyzed

Table 35
Student T-Test Comparing WMFT Time Scores Between Treatment and Post-treatment

Task	T	df	p
1	-0.303	13.727	.766
2	-1.898	14.0	.079
3[1]			
4	0.037	4.715	.972
5	0.069	6.477	.947
6	0.856	12.644	.408
7	-2.167	4.327	.091
8	0.9	11.136	.387
9	-0.573	7.186	.584
10	0.989	13.939	.34
11	2.876	12.038	.014
12	.0919	11.791	.377
13	-0.072	13.03	.944

[1]Data not statistically analyzed

Table 36
Student T-Test Comparing WMFT Time Scores Between Pretreatment and Post-treatment

Task	T	df	p
1	1.207	3.181	.31
2	-1.012	6.0	.35
3[1]			
4	0.05	5.998	.962
5	-0.013	5.537	.99
6	-0.116	5.919	.911
7	-3.019	6.0	.023
8	-2.608	3.939	.06
9	1.576	4.16	.188
10	.0838	3.241	.459
11	-0.055	4.343	.958
12	-1.449	3.222	.237
13	-0.626	6.0	.555

[1]Data not statistically analyzed

Table 37
Kruskal Wallis Test Comparing WMFT Categorical Scores Between All Phases

Task	χ^2	df	p
1	8.908	2	.012
2	2.292	2	.318
3	0.930	2	.628
4	0.930	2	.628
5	1.407	2	.495
6	1.407	2	.495
7[1]			
8	2.047	2	.359
9	4.7	2	.095
10	3.167	2	.205
11	1.267	2	.531
12	0.792	2	.673
13	0.993	2	.609

[1]Data not statistically analyzed

Table 38
Mann-Whitney Test Comparing WMFT Categorical Scores

Task	Phases Compared	Mann-Whitney U	Z	p
1	Pretest & Treatment	4.0	-2.877	.004
1	Pretest & Post-test	2.0	-2.049	.04

Significant difference was found to be negative, indicating deterioration, between pretreatment and post-treatment, after running a student T-test, for task 7 (weight to box) time scores ($\underline{T}$ (6) = -3.019, $\underline{p}$ = .023). Quality of movement was not assessed for this task because the added wrist weight may have affected the subject's movement patterns. Therefore, the Kruskal-Wallis Test was not used for this task.

A significant difference was found to be negative for task 11 (lift paper clip) time scores was also found between pretreatment and treatment ($\underline{T}$ (13.39) = -3.459, $\underline{p}$ = .004) and positive significant difference between treatment and post treatment ($\underline{T}$ (12.04) = 2.876, $\underline{p}$ = .014). Kruskal-Wallis Testing revealed no significance in quality of movement for this task.

Time scores from the Nine Hole Peg Test (9HPT) were plotted in graph form for visual analysis (see figures 8 & 9). The subject's right hand was assessed, as well as his left. Mean scores for all three phases were calculated for both hands. Left hand pretest mean score was 208.75 sec, treatment mean score was 157.87 sec, and post-test mean score was 204.35 sec. Right hand pretest mean score was 44.53 sec, treatment mean score was 38.35 sec, and post test mean score was 37.18 sec. Celeration lines were calculated and drawn into the graphs on each chart to display the trend in each phase.

Celeration lines among each phase enable one to determine the trend of scores. According to the celeration lines in figure 8, the subject showed an increase (his score worsened) in time scores during the pre-test and post-test sessions for his left hand. However, an improvement in time scores is observed during the treatment phase. Figure 9 shows celeration lines calculated for the right hand. The subject

Figure 8

Time scores of the left hand from the 9HPT. Scores are divided into the three study phases by vertical lines. Celeration lines have been added for visual analysis, which reveal improvement in scores during the treatment phase.

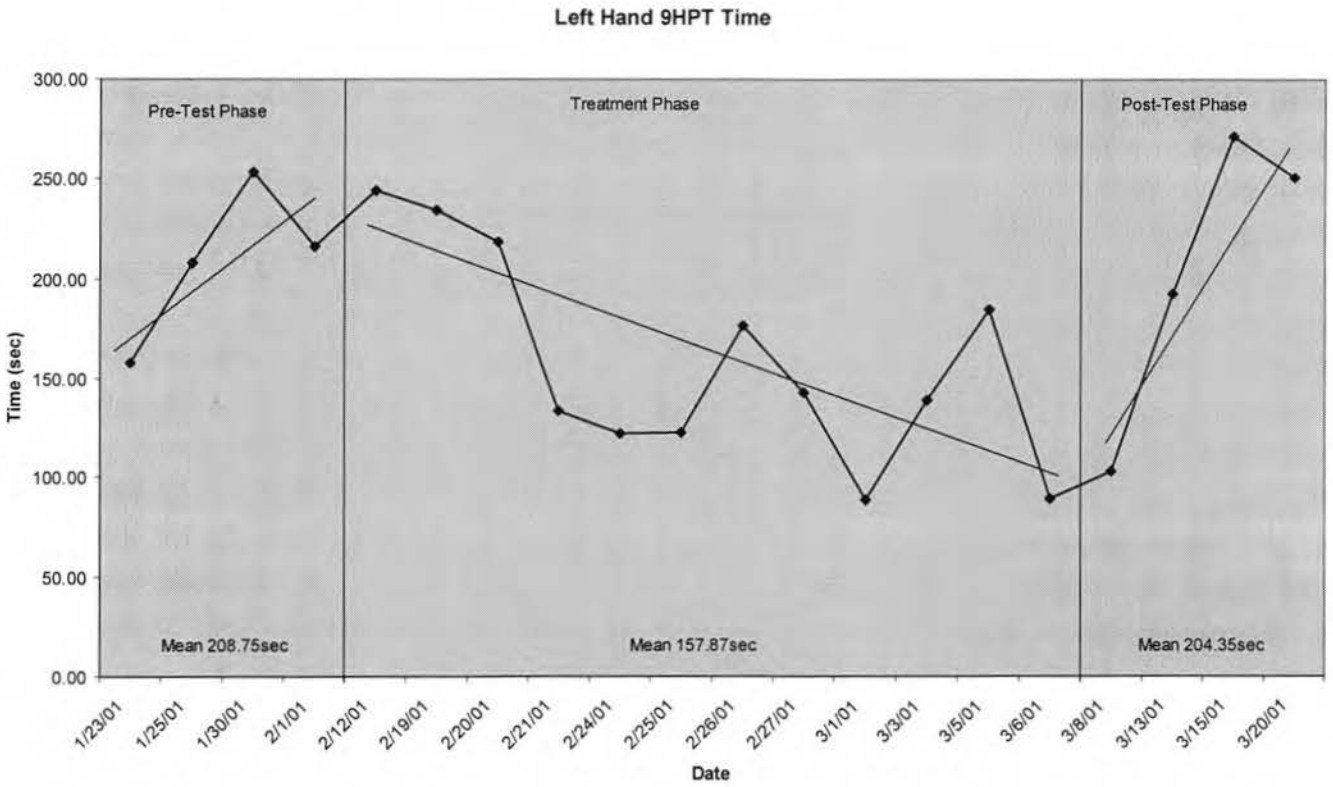
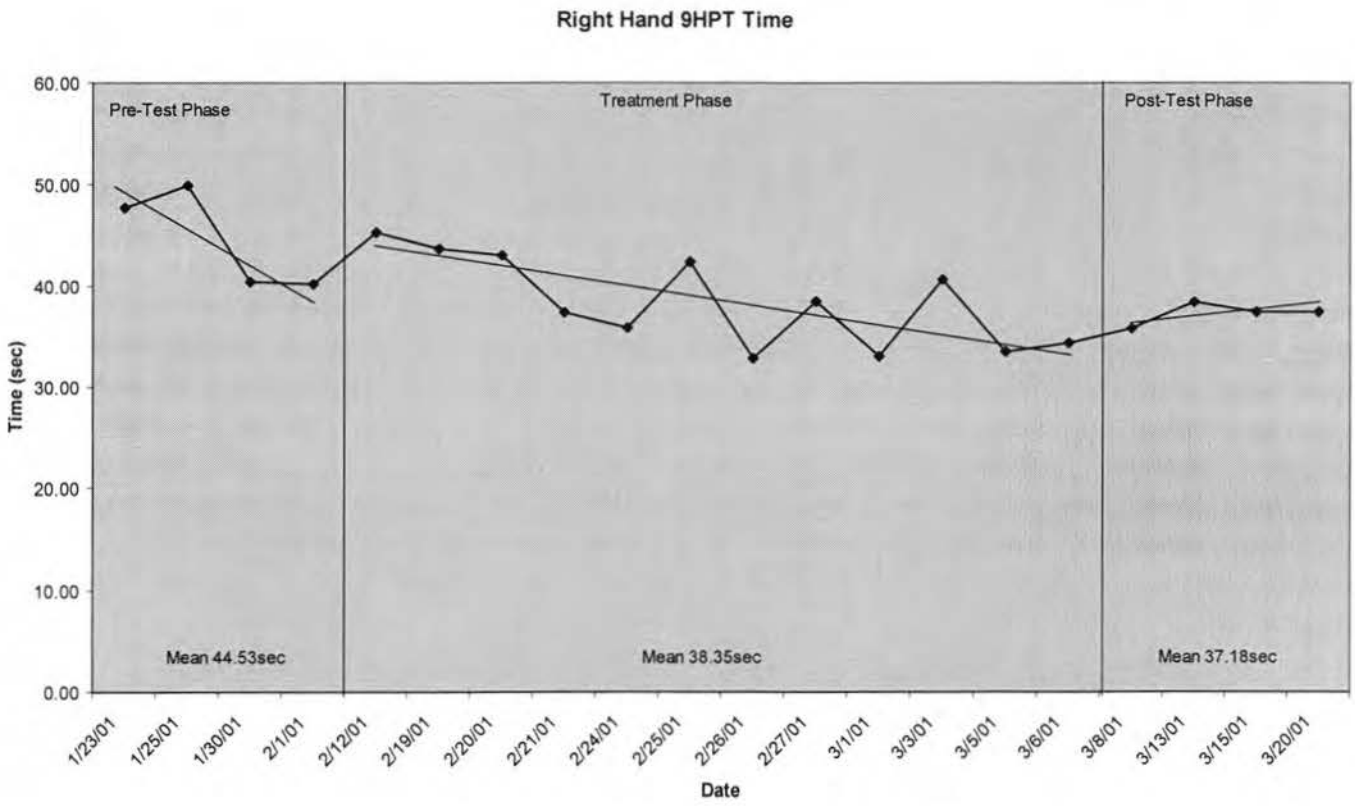


Figure 9

Time scores of the right hand from the 9HPT. Scores are divided into the three study phases by vertical lines. Celeration lines have been added for visual analysis, which reveal slight improvement in scores during the pretest and treatment phase. A minimal decline can then be observed during the post test phase, however the mean in this phase is still lower than the previous two.



demonstrates improvements in right hand time score during the pre-test and treatment phase, however his time scores during the post-test phase slightly increase.

The second and third hypotheses were not supported since significant improvements were scarce in WMFT data. Additionally, improvements that were seen in the 9HPT were not sustained following the treatment.

CHAPTER V: DISCUSSION

Occupation-based constraint induced movement therapy did not have a profound effect on overcoming learned non-use and increasing quality and/or speed of motor control in this study. Based upon the results from the MAL, 9HPT and the WMFT, none of the three hypotheses was supported at the completion of the study. The results from the 9HPT do show that the subject improved in speed of left-hand motor control during the treatment phase. However, this improvement was not maintained into the post-test phase. Additionally, significant changes were noted only in the WMFT test, tasks 1, 7, and 11 between the pretest and treatment phases, of which some displayed deterioration of motor control. The results from this study are not congruent with results from earlier studies that found CI therapy to improve motor control and/or decrease the level of learned non-use following intervention.

Motor Activity Log: Functional Use

The Motor Activity Log was used to test the hypothesis that stated the subject would demonstrate increased functional use of the involved extremity while engaging in everyday activities, following the study. Results from the MAL show that throughout the study several tasks improved in both frequency and quality of movement from the subject's perspective. Other tasks, however, appeared to decrease both in frequency and quality of movement. This variance in responses by the subject throughout the study is the underlying rationale for the conclusion that this hypothesis was not supported.

A further examination of the MAL shows that tasks that improved included common tasks that are engaged in daily such as opening a drawer, picking up the

phone and picking up a cup by a handle. Simple ADL tasks also improved in quality and/or frequency. Tasks that decreased in frequency and/or quality include tasks such as donning and doffing socks and shoes, getting up from a chair, and pulling a chair in once seated.

The tasks that improved or increased in frequency can broadly be grouped as household tasks and can be completed with one extremity in most cases. Additionally, the tasks that improved can also broadly be grouped as tasks that are comprised of a unilateral reach and recover type movement. In contrast, the items that worsened can also be broadly grouped as ADL tasks that are more personal in nature. These tasks can also be grouped as tasks that require bilateral extremity use to complete.

Prior studies that used the MAL as an assessment tool to measure change in use of the involved extremity do not attempt to categorize or group the subtasks that make up the assessment. Instead, the results that are presented from the MAL are discussed as a whole (Kunkel et al., 1999; Blanton & Wolf, 1999).

A possible mechanism for negative change may be the client's overstatement of his ability during the initial phase of the study. During pre-test, the subject reported that he was capable of donning and doffing his socks and shoes. He further reported that he was able to get up from a chair using the armrests to push himself up, as well as pull a chair in, once seated. It was evident, both from working with the subject and through nursing home staff reports that he rarely transferred from sitting to standing independently. Furthermore, he nearly always sat in his wheelchair, which would decrease his opportunities to pull a standard chair in at a table setting. It

was apparent from the beginning that his answers to the MAL were not always congruent with his actual actions.

Second, the subject reported in the beginning that he was able to don and doff his socks and shoes, and often completed these tasks independently. During the treatment session, possibly because he felt more comfortable around the researcher he disclosed that he actually did not often complete this task because it was very difficult for him. On the MAL, this change was documented as a drastic decrease in function, however, there was probably no change in actual frequency or quality from pretest to post-test. It is suspected that the subject probably answered inaccurately. To prevent this from occurring in the future, an assessment that is more observation- based as opposed to self-report, would yield more valid results.

It is difficult to know if the tasks that were documented as improved did in actuality improve in frequency and quality. Many of these tasks as stated above are tasks that can be completed unilaterally, in a reach and recover type of movement, and are less personal in nature than the tasks that decreased in frequency or quality. The results may be attributed to an actual improvement or an increase in awareness of the use of the impaired extremity. The activities used during treatment sessions could largely be defined as reach and recover type tasks. For example, many games and craft activities required the participant to reach with one extremity to accomplish a goal, such as placing a game piece, followed by a return to the previous posture. The large number of tasks with this type of movement during treatment could have resulted in an increase in common household tasks completed with the involved extremity. The very nature of this study precluded tasks that are bilateral in nature,

and few bilateral tasks, if any, were completed during treatment. This may be one explanation why certain tasks improved and others worsened according to the MAL, during this study.

The subject was observed on a few occasions completing some of the tasks in the MAL. During this time, the subject was not cued to use his involved extremity. On most occasions, tasks such as opening a door by turning a doorknob were completed with the uninvolved extremity. When attention was drawn to his involved extremity, he would attempt to use that extremity and often fail to successfully complete the task. The subject's therapists and staff occasionally reported that the subject was demonstrating an increased use of his impaired extremity for common tasks such as eating, however, this was not consistent.

Whether or not his answers to the MAL questions actually reflected his physical attempts to complete tasks with his involved extremity, it is thought that the subject did heighten his awareness about using his impaired extremity through his verbalizations during the treatment days. An increased awareness of the involved extremity may be the first step needed in overcoming learned nonuse. Although not discussed in previous literature, a physical and visual cue such as a restraint may be an effective method to increase attention to the impaired extremity. Such a device may increase awareness of the involved extremity since left side neglect can often be seen in people who suffer right CVA.

Tasks that did not show change in frequency of "yes" responses included washing and drying hands, opening a refrigerator, getting in/out of a car and pulling a chair away from a table before sitting down. These tasks did not change either

because the subject either always or never completed them during the study. Washing and drying hands were two tasks that the subject always completed and therefore scored a "4" for each phase. In this case, one can only look to quality of movement for trend analysis. For these tasks, the subject reported an increase in quality between all three phases. The other tasks that were never completed and received a"0" score for frequency of "yes" responses did so because it wasn't possible or did not occur within the time-line of this study.

The MAL proved to be a difficult assessment to use in this study. Its length of administration often frustrated and fatigued the subject, and its rating scales were frequently confusing. The subject needed constant verbal cueing to rate himself with both scales, which did not improve over time. Rarely did he demonstrate understanding of or learned knowledge of the use of the scales. In addition, the subject had difficulty understanding the difference between scales. The 'Amount Scale' further increased his confusion since the subject stated that he could not remember how much he used his involved extremity before the CVA. Last, and most important, the subject answered the questions based on speculation rather than actual memory. When given the evaluation questions, he would make comments such as, "I think I would probably use my left arm for that task....". He could not remember specific occasions from which to rate his actual amount and quality of use.

From a research viewpoint, the MAL attempts to gather important information. An evaluation of this nature is essential to document a change in amount of use outside therapy sessions. To successfully demonstrate a change in learned non-use, a researcher must gather data regarding the subject's amount of use

outside a treatment setting. To increase it's success with clients of similar cognitive capabilities to the subject in this study, the MAL needs revisions to decrease its administration time. Additionally, the scales should be modified so that a clear difference is seen between the scales as well as each point value on the scales.

Attempting to document a client's behavior outside of therapy is a difficult task and perhaps one that needs different measures to capture the data. Should the subject in this study have demonstrated higher cognitive functions, it is felt that his confusion, frustration, and fatigue would have been less of a factor. To successfully use the MAL in it's original form, it is suggested that clients be evaluated first with a cognitive measure that delves deeper than the MMSE. Clients should possess adequate long and short-term memory, mental flexibility, and attention span.

Based upon the subject's confusion and frustration with the MAL, it is nearly impossible to determine if the actual amount of use and quality of movement of his left extremity changed. All data, however, were gathered from the client without probing and reflects his own perceptions of his quality and frequency of left arm use. A change of score between pre-test and post-test may or may not represent an actual physical or behavioral change. However a change in score may better reflect a change in perception about a particular task or tasks.

Quality and Speed of Movement

The Wolf Motor Function Test and Nine Hole Peg Test were used to measure the remaining two hypotheses. These stated that the subject would demonstrate increased speed and quality of movement following the study. Based on the small amount of significance found in the data from the WMFT scores, and the

improvements that were not sustained in the 9HPT, these hypotheses were also not supported.

As opposed to the MAL, results from the WFMT and 9HPT provide more objective evidence about change in motor function of the involved extremity. Whether or not the subject perceived his motor function as improving or worsening during the study, the WMFT and 9HPT gathered data that measured motor speed and quality of movement. These assessments were administered in nearly the same circumstances on every occasion.

The Wolf Motor Function Test: Quality and Speed of Movement

Of the WMFT's thirteen standardized tasks used to assess the subject's movement, incorporating all joints and muscle groups, significant differences only occurred in tasks 1,7 and 11. In two tasks, significant results were found, but the direction of the change was negative, indicating a reduction in performance. Similar to the MAL, the WMFT data from this study does not concur with prior studies, where significant improvement was found (Kunkel et al, 1999; Blanton & Wolf, 1999).

As seen in chapter IV (Tables 34-38), task 1 (forearm to table, side) shows significant difference for quality of movement between pretreatment and treatment, as well as between pretreatment and post-treatment. Task 1, however, is the only task where significance is always positive. In this task, the subject demonstrated better control moving his involved extremity over the course of the study.

Task 7 shows a negative significant difference, representing a decrease in time scores between pretreatment and post-treatment. The subject completed the task

significantly slower following treatment, than in the pre-testing phase. Different from the other tasks, task 7 requires that the subject wear a wrist-weight. Because of this factor, task 7 is largely a measure of strength, which was not a dependent variable in this study. This negative relationship, therefore, may represent a change in muscle strength or general levels of energy between these phases.

Task 11 also shows significant negative change in time score between pretreatment and treatment. Task 11 further shows significant improvement in time scores between treatment and post-treatment, however no significance is seen between pre and post-treatment. Task 11 requires the subject to pick up a paper clip from the flat tabletop. This task is also a "reach and retrieve" task that requires a great degree of dexterity. The increased ability to complete this task quickly late in the study does not coincide with the decrease in 9HPT time score.

Looking across the entire course of the study by comparing pretreatment to post-treatment, occupation-based CI therapy as carried out in this study did not have a large effect on motor control as measured by the WMFT. Improvements were seen only in quality of movement in task 1.

Significant improvements in motor control were probably not seen for the same reasons as discussed earlier in this chapter regarding the MAL results. The subject had difficulty conforming to the proposed methodology, and for this reason, the protocol would not be followed as originally planned. For the majority of treatment days, the subject did not follow the restraint-wearing schedule. As a result, the subject did not engage in activities using only his involved extremity as much as he could have. If the participation in the therapy schedule had been adhered to at a

level similar to previous studies, one may have seen more significant changes in motor performance. Additionally, the subject's emotional status may have affected his physical performance during the WMFT. It was often noted that if the subject was frustrated, his performance would suffer. This was observed several times when the subject needed to repeat a task in the assessment.

The Nine Hole Peg Test: Speed of Movement

The results from the 9HPT are the most promising. Although there was not a significant net change from pre-test to post-test in speed of left hand movement, the subject demonstrated improved dexterity and motor control during the treatment phase. The subject's treatment mean improved by nearly 50 seconds during the treatment session with his left hand, while his right hand improved only by approximately 6 seconds. Once treatment was ended however, the subject quickly returned to a level of dexterity similar to that in the pre-test phase.

The right hand was assessed with the 9HPT to determine if a practice effect might have altered results. The right/uninvolved hand demonstrated a slight improvement during the course of the study. However, differently from the left hand, it maintained this improvement throughout the post-test phase.

This data suggests that CI therapy may be an effective form of treatment to improve motor control as assessed with the 9HPT, at least temporarily. These results are not consistent with prior studies, such as Dr. Taub's, that displayed improvements in function that were maintained for two years following treatment. This inconsistency among results may be attributed to the many confounding factors that prevented the study from being carried through as it was originally designed. It may

also mean that with fewer hours of treatment per day, increasing the duration of treatment may be needed for improvement to be sustained. This needs further research to evaluate the time frame for therapy to produce the best results.

General Considerations

These varying results from this study can possibly be attributed to several factors that could not be predicted nor controlled. Additionally, the unique characteristics of the individual subject in this study may have contributed to the results. While the results may not be able to be generalized to the chronic stroke population, they do however, raise questions about CI therapy for further research, and may assist other research teams when creating future studies.

There are many characteristics of this study that were positive and facilitated its completion. The subject involved was very eager to participate, and continued to remain interested throughout the entire process. He was concerned about the effects of the CVA, and took an active role in his own recovery process during the treatment sessions. His willingness to participate in the lengthy pretest and post-test sessions as well as the many hours of treatment demonstrated his will to overcome the effects of his stroke. The subject's participation was further supported by his family members as well as his therapists at the nursing home.

One of the major concerns about the study was the use of a restraint for many hours and many days. The subject accepted the restraint, aware that it was temporary, and although became frustrated at times, he never completely rejected the restraint. Although data gathered during the three phases is varied, it is thought by the researcher that based on the client's verbalizations the restraint increased his

awareness of using the impaired extremity. This was not measured, however. This is thought to be an important factor for overcoming the phenomenon of learned non-use. One major difference and advantage of this study is that the treatment sessions took place primarily in the subject's own environment. He could socialize with his peers, spend time in his own room, be near the people and places he was comfortable with, all while wearing the restraint and receiving treatment. This is thought to have increased the likelihood of this study's completion and subject compliance.

In contrast, several factors that were not anticipated made it difficult to carry out this study as it was originally designed. During the first and second weeks of the treatment phase, the subject's health interfered with his participation. Because of this, the length of time from the pre-test phase to the treatment phase was lengthened. Although it appears that this gap in time did not influence the results, it cannot be known for sure what the effects were. Throughout the study, the subject experienced pain and discomfort while sitting. This pain necessitated frequent rest-breaks, often in supine and without the restraint. Although this time was used regularly for MAL assessment, it ultimately decreased the amount of time that the subject was engaged in the therapeutic protocol.

Often during the study, the subject demonstrated signs of depression. The Geriatric Depression Scales were used on two occasions to assess for depressive symptoms. Both times, the subject scored in the "moderate" range, indicating that depression may have been present during the study. If the scores from these scales represent accurate findings, then the subject's motivation and ability to participate outside of treatment times may have been compromised by his emotional state.

A key factor, and probably one that greatly affected the results of this study was the subject's decreased adherence to the restraint-wearing schedule during the afternoons and evenings of the treatment phase. The subject and nursing staff reported that on a few occasions the restraint was used, but for the majority of time it was not worn after the scheduled treatment sessions. The nursing staff (A and B shifts) was informed about the restraint-wearing schedule, however, they were not successful in its implementation. On one occasion when they were involved in donning the restraint, it was put on the wrong extremity, which demonstrated their decreased understanding about the purpose of the restraint. The subject's inability to recognize that the restraint was on the incorrect extremity leads one to believe that cognitively he may not of been capable of adhering to the sling-wearing schedule outside of therapy. Although his score on the MMSE was higher than the inclusionary criteria demanded, it is apparent that his cognition may not have been at the level needed to sufficiently adhere to the restraint-wearing schedule without increased supervision. This however, is only an assumption and not known for sure as no other cognitive evaluations were used to assess his memory, problem solving, sequencing and other cognitive functions. The above example about incorrectly donning the restraint was early in the treatment phase and it is thought that as time progressed, he was habituated to wearing the sling on the correct extremity.

To increase success in a treatment protocol such as was followed by this study, the subject's primary caregiver should also be incorporated at a higher level. This would increase subject adherence to the restraint-wearing schedule outside of the treatment sessions.

Finally, the subject is right hand dominant, with left side hemiparesis. Engaging in CI therapy forced him to use his involved/non-dominant extremity for tasks that he would most likely never have completed with his left side. Tasks such as brushing teeth, shaving and opening a door are common tasks that are commonly completed with the dominant hand. Participating in this study not only was forcing him to use his impaired extremity, but it was forcing him to use his non-dominant side. He was in effect, performing unfamiliar tasks for that hand, rather than practicing previously mastered skills.

It is difficult to completely understand why there were not more significant results. The subject received many hours of treatment, in which time he was engaged in fine and gross motor tasks with his involved extremity. It was not expected that each item on the WMFT or MAL would show a significant change in performance, but it was believed that the majority of tasks would show improvement. It may be that when the client's day could not be completely rearranged to follow the previous protocol, a longer period of time is necessary to achieve the desired results. Or, it may be that occupation based CI therapy is not as effective as the original form of constraint therapy. Further research is necessary to determine what protocol yields the most promising results.

Additional research with larger sample sizes is needed to determine if occupation-based CI therapy is an effective form of therapy to increase quality of movement of a hemiparetic extremity. Future subjects who participate in studies such as this should be assessed with a cognitive tool other than the MMSE. A study that looks at a subject's cognition relative to his ability to adhere to a home program

would be beneficial to the subject selection processes in research of this nature. Obviously, cognition is not the only factor that should be taken into account when creating a home program.

Research that looks at clinic-based CI therapy in day sessions should be evaluated to determine what duration of less rigorous treatment would yield similar results. A study that engages the subjects in 6 hours of CI therapy daily for 3-4 weeks, instead of wearing a restraint for 90% of waking hours for two weeks would be beneficial. Additionally, research that compares CI therapy to other forms of motor rehabilitation in a schedule as rigorous as the one used in CI therapy is needed. These research areas would add to the knowledge base about motor rehabilitation and increase the options for motor relearning that clinicians may choose from.

CHAPTER VI: SUMMARY

CI therapy is a motor remediation technique that has been shown in several studies to effectively increase the actual amount of use of the involved upper extremity after intervention (Miltner, Bauder, Sommer, Dettmers, & Taub, 1999; Taub, Uswatte, & Pidikiti, 1999). Although this treatment is not appropriate for all stroke patients, it may be promising for 20-25% of chronically impaired individuals with some active motion (Taub, Uswatte, Pidikiti, 1999). In order to use this technique in occupational therapy, additional research is necessary. Studies that support or invalidate the effectiveness of an occupation-based constraint therapy protocol will aid therapists in choosing treatment techniques.

The objective of this study was to evaluate the effectiveness of occupation-based treatment on functional use, quality, and speed of movement, within the typical CI therapy protocol. This single subject study was designed to incorporate the use of occupational tasks as treatment activities, with a standard CI therapy protocol.

One subject was recruited to participate in this study. He suffered a stroke approximately six months prior, and met the inclusionary criteria established for this study. Two weeks of pre-testing and post-testing were performed, separated by approximately 3 weeks of non-consecutive treatment days. Treatment consisted of activities such as crafts, games, and ADL's, while the subject wore a restraint on his right/uninvolved extremity.

Data were collected during each session using the WMFT, MAL, and 9HPT. These assessments gathered both subjective and objective information regarding quality and quantity of movement.

Significant improvements were observed in the involved extremity for some motor tasks on the WMFT. Furthermore, improvements in dexterity were seen during the treatment phase through the 9HPT data. These improvements, however, were not sustained following treatment. Improvements were also noted in the results of the MAL, however these improvements were not consistent throughout, or thought to be totally accurate.

Although the results from this study are varied, the study was successful in many ways. First, a subject was found with relative ease, who met the inclusionary criteria, and was able to participate throughout the duration of the study. This study was carried out in a more realistic method than previous studies, and overcame obstacles that would likely be faced by other treating therapists. Improvements found in speed of motor control during this study are encouraging and suggest that with further research, a more successful protocol for CI therapy can be established for real world settings.

Conversely, this study attempted to follow its original methodology as closely as possible. Factors that were not anticipated arose throughout the course of the study that altered its path. As a result, changes were made when necessary. However, not all of the unforeseen problems could be corrected. A major change in the methodology was the shift of treatment from the Ithaca College clinic to the subject's nursing home. Second, the subject did not meet the restraint-wearing schedule outside of treatment, as described in the original methodology. Factors such as these and others are thought to have affected the results of this study.

Further research with a larger sample size is needed to collect objective data that will generalize to the chronic stroke population. Additional research is also needed to determine if similar results can be obtained from providing CI therapy fewer hours per day, for a longer duration of time. A protocol that is doable for real world settings must be developed and tested. Last, research is needed that looks at CI therapy among clients where the involved side is the dominant side, versus clients with the involved side being the non-dominant side.

REFERENCES

Andrews, K., & Stewart, J. (1979). Stroke recovery: He can but does he? Rheumatology and Rehabilitation, 18, 43-48.

Association, T. A. S. (1999). Stroke is a medical emergency, call 9-1-1! Available: http://www.strokeassociation.org/ [2001, October 23].

Blanton, S., & Wolf, S. (1999). An application of upper extremity constraint induced movement therapy in a patient with subacute stroke. Physical Therapy, 79(9), 847-853.

Candia, V., Elbert, T., Altenmueller, E., Rau, H., Schaefer, T., & Taub, E. (1999). A constraint-induced movement therapy for focal hand dystonia in musicians. The Lancet, 353, 42.

Crago, J. E., Yakley, S. R., DeLuca, S. C., Allen, F. V., Shaw, S. E., Pidikiti, R. D., & Taub, E. (2000). Constraint induced movement therapy to improve upper extremity function in lower functioning subjects following stroke: A case study. Physical Therapy, 80(5), 17-18.

Crocker, M. D., MacKay-Lyons, M., & McDonnell, E. (1997). Forced use of upper extremity in cerebral palsy: a single case design. The American Journal of Occupational Therapy, 51(10), 824-833.

Dennis, M., Burn, J., Sandercock, P., Bamford, J., Wade, D., & Warlow, C. (1993). Long-term survival after first-ever stroke: The oxforshire community stroke project. Stroke, 24, 796-800.

Elbert, T., Flor, H., Birbaumer, N., Knecht, S., Hampson, S., Larbig, W., & Taub, E. (1994). Extensive reorganization of the somatosensory cortex in adult humans after nervous systems injury. Neuroreport, 5, 2593-2597.

Ferrucci, L., Bandinelli, S., Guralnik, J. M., Lamponi, M., Bertini, C., Falchini, M., & Baroni, A. (1993). Recovery of functional status after stroke: A postrehabilitation follow-up study. Stroke, 24, 200-205.

Folstein, M., Folstein, S., & McHugh, P. (1975). Mini-Mental State: A Practical Method for Grading the Cognitive State of Patients for the Clinicians. Journal of Psychiatric Researh, 12, 189-198.

Kielhofner, G. (1997). Conceptual Foundations of Occupational Therapy (2 ed.). Philadelphia: Jean-Francois Vilain.

Kopp, B., Kunkel, A., Flor, H., Platz, T., Rose, U., Mauritz, K., Gresser, K., McCulloch, K., & Taub, E. (1997). The Arm Motor Ability Test: Reliability, validity and sensitivity to change of an instrument for assessing disability in activities of daily living. Archives of Physical Medicine and Rehabilitation, 78, 615-620.

Kunkel, A., Kopp, B., Muller, G., Villringer, K., Villringer, A., Taub, E., & Flor, H. (1999). Constraint induced movement therapy for motor recovery in chronic stroke patients. Archives of Physical Medicine and Rehabilitation, 80, 624-628.

Loewen, S., & Anderson, B. (1990). Predictors of stroke outcome using objective measurement scales. Stroke, 21, 78-81.

Mathiowetz, V., & Haugen, J. (1995). Evaluation of Motor Behavior: Traditional and Contemporary Views. In C. Trombly (Ed.), Occupational Therapy for Physical Dysfunction (4 ed.). Baltimore: Williams and Wilkins.

Mathiowetz, V., Weber, K., Kashman, N., & Volland, G. (1985) Adult norms for the Nine Hole Peg Test of finger dexterity. Occupational Therapy Journal of Research, 5, 24-38.

Miltner, W., Bauder, H., Sommer, M., Dettmers, C., & Taub, E. (1999). Effects of constraint-induced movement therapy on patients with chronic motor deficits after stroke: A replication. Stroke, 30, 586-592.

Morris, D. M., Crago, J. E., DeLuca, S. C., Pidikiti, R. D., & Taub, E. (1997). Constraint-induced movement therapy for motor recovery after stroke. Neurorehabilitation, 9, 29-43.

Nakayama, H., Jorgensen, H., Raaschou, H., & Olsen, T. (1994). Compensation in recovery of upper extremity function after stroke: The copenhagen stroke study. Archives of Physical Medicine and Rehabilitation, 75, 852-857.

(NDTA), N. D. T. A. Education. Available: http://www.ndta.org/edu [2001, October 29].

Norkin, C., & White, D. J. (1995). Measurement of Joint Motion: A Guide to Goniometry (2 ed.). Philadelphia: F.A. Davis Company.

Nwaobi, O. (1987). Nondominant arm restraint and dominant arm function in a child with athetoid cerebral palsy: Electromyographic and functional evaluation. Archives of Physical Medicine and Rehabilitation, 68, 837-839.

Ostendorf, C. G., & Wolf, S. L. (1981). Effect of forced use of upper extremity of a hemiplegic patient on changes in function. Physical Therapy, 61(7), 1022-1028.

Pedretti, L. W. (1996). Movement Therapy: The Brunnstrom Approach to Treatment of Hemiplegia. In L. W. Pedretti (Ed.), Occupational Therapy: Practice Skills for Physical Dysfunction (4 ed.). San Jose, CA: Mosby.

Pope-Davis, S. A. (1996). The proprioceptive neuromuscular facilitation approach. In L. W. Pedretti (Ed.), Occupational therapy: Practice skills for physical dysfunction (4 ed., pp. 417). St. Louis, MO: Mosby.

Ryerson, S. D. (1995). Hemiplegia. In D. A. Umphred (Ed.), Neurological Rehabilitation (3 ed.). St. Louis, MO: Mosby.

Stein, F., & Cutler, S. (1998). Leisure Occupations Interest Inventory (LOII), Psychosocial Occupational Therapy (pp. 423-426). San Diego, CA: Singular Publishing Group.

Taub, E. (1999). New discovery equals change in clinical practice. Journal of Rehabilitation and Research Development, 36(3), 7.

Taub, E., Crago, J. E., & Uswatte, G. (1998). Constraint induced movement therapy: A new approach to treatment in physical rehabilitation. Rehabilitation Psychology, 43, 152-170.

Taub, E., Miller, N. E., Novack, T. A., Cook, E. W. I., Fleming, W. C., Nepomuceno, C. S., Connell, J. S., & Crago, J. E. (1993). Technique to improve chronic motor deficit after stroke. Archives of Physical Medicine and Rehabilitation, 74, 347-354.

Taub, E., & Uswatte, G. (2000). CI therapy and massed practice: a reply to van der Lee et al [letter to the editor]. Stroke, 31, 987-988.

Taub, E., Uswatte, G., & Pidikiti, R. D. (1999). Constraint induced movement therapy: A new family of techniques with broad application to physical rehabilitation - a clinical review. Journal of Rehabilitation and Research Development, 36, 237-251.

Taub, E., & Wolf, S. (1997). Constraint induced movement techniques to facilitate upper extremity use in stroke patients. Topics in Stroke Rehablitation, 3, 38-61.

Thompson, D. (1999). Constraint induced movement therapy for motor recovery in chronic stroke patients. Physical Therapy, 79(12), 1231-1232.

Trombly, C. (1995a). Occupational Therapy for Physical Dysfunction (4 ed.). Baltimore: Williams & Wilkins.

Trombly, C. (1995b). Theoretical Foundations for Practice. In C. Trombly (Ed.), Occupational Therapy for Physical Dysfunction (4 ed.). Baltimore: Williams and Wilkins.

Uswatte, G., Miltner, W., Foo, B., Varma, M., Moran, S., & Taub, E. (2000). Objective measurement of functional upper-extremity movement using accelerometer recordings transformed with a threshold filter. Stroke, 31, 662-667.

van der Lee, J., Beckerman, H., Lankhorst, G., Bouter, L., Blanton, S., & Wolf, S. (2000). Constraint induced movement therapy (for patients with upper-extremity hemiparesis). Physical Therapy, 80(7), 711.

van der Lee, J., Wagenaar, R. C., Lankhorst, G., Vogelaar, T. W., Deville, W. L., & Bouter, L. (1999). Forced use of the upper extremity in chronic stroke patients: Results from a single-blind randomized clinical trial. Stroke, 30, 2369-2375.

Weerdt, W. J. G., & Harrison, M. A. (1985). Measuring recovery of arm-hand function in stroke patients: A comparison of the Brunstrom-Fugl-Meyer test and the Action Research Arm test. Physiotherapy Canada, 37(2), 65-70.

Wilson, D., Baker, L., & Craddock, J. (1984). Functional test for the hemiparetic upper extremity. The American Journal of Occupational Therapy, 38(2), 159-164.

Wolf, S., Lecraw, D., Barton, L., & Jann, B. (1989). Forced use of hemiplegic upper extremities to reverse effect of learned nonuse among chronic stroke and head injured patients. Experimental Neurology, 104, 125-132.

Woodson, A. (1989). Stroke. In C. Trombly (Ed.), Occupational therapy for physical dysfunction (4 ed.). Baltimore, MD: Williams & Wilkins.

APPENDIX A

APPENDIX A: MAL FREQUENCY TABLES

Table 1
Item Number: 1 (Turn on Light Switch)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			3						**1**				
A1	Amount		0	1 *	2 **	3	4	5					
	How Well		0	1 *	2 **	3	4	5	1 *	2	3	4	5
			4						**0**				
B	Amount		0	1	2	3	4	5					
	How Well		0	1	2 **	3 *	4 *	5	1	2	3	4	5
			4						**0**				
A2	Amount		0	1 *	2	3	4 ***	5					
	How Well		0	1	2	3 ***	4 *	5	1	2	3	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 2
Item Number: 2 (Open Drawer)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			1						3				
A^1	Amount		0	1	2 *	3	4	5					
	How Well		0	1	2 *	3	4	5	1 ***	2	3	4	5
			3						1				
B	Amount		0	1	2	3	4	5					
	How Well		0	1	2	3 *	4 **	5	1 *	2	3	4	5
			4						0				
A^2	Amount		0	1	2 **	3 *	4 *	5					
	How Well		0	1	2	3 ***	4 *	5	1	2	3	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 3
Item Number: 3 (Remove Item of Clothing from Drawer)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			2						2				
A^1	Amount		0	1	2 **	3	4	5					
	How Well		0	1	2 *	3 *	4	5	1	2 *	3	4 *	5
			3						1				
B	Amount		0	1	2	3	4	5					
	How Well		0	1	2 *	3 *	4 *	5	1	2	3	4 *	5
			4						0				
A^2	Amount		0	1 *	2	3	4 ***	5					
	How Well		0	1	2	3 *	4 ***	5	1	2	3	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 4
Item Number: 4 (Pickup Phone)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			0						**4**				
A^1	Amount		0	1	2	3	4	5					
	How Well		0	1	2	3	4	5	1 ****	2	3	4	5
			1						**3**				
B	Amount		0	1	2	3	4	5					
	How Well		0	1	2	3	4 *	5	1 ***	2	3	4	5
			1						**3**				
A^2	Amount		0	1 *	2	3	4	5					
	How Well		0	1 *	2	3	4	5	1 ***	2	3	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 5
Item Number: 5 (Wipe off kitchen counter or other surface)

Study Phase[a]		Number of "Yes" Responses						Number of "No" Responses				
		0						**4**				
A^1	Amount	0	1	2	3	4	5					
	How Well	0	1	2	3	4	5	1	2 *	3	4 ***	5
		0						**4**				
B	Amount	0	1	2	3	4	5					
	How Well	0	1	2	3	4	5	1 *	2	3	4 ***	5
		4						**0**				
A^2	Amount	0	1 ***	2 *	3	4	5					
	How Well	0	1	2 *	3 ***	4	5	1	2	3	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 6
Item Number: 6 (Get in/out of car)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			0						4				
A^1	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1	2	3	4 ****	5
			0						4				
B	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1	2	3	4 ****	5
			0						4				
A^2	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1	2	3	4 ****	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 7
Item Number: 7 (Open a refrigerator)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			0						4				
A^1	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1	2	3	4 ****	5
			0						4				
B	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1	2	3	4 ****	5
			0						4				
A^2	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1	2	3	4 ****	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 8
Item Number: 8 (Open a door by turning a knob)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			3						1				
A^1	Amount		0	1	2 ***	3	4	5					
		How Well	0	1	2 ***	3	4	5	1 *	2	3	4	5
			2						2				
B	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3 *	4 *	5	1 **	2	3	4	5
			4						0				
A^2	Amount		0	1 *	2 ***	3	4	5					
		How Well	0	1 *	2	3 ***	4	5	1	2	3	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 9
Item Number: 9 (Use a TV remote control)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			0						4				
A^1		Amount	0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1	2	3 ***	4 *	5
			0						4				
B		Amount	0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1 ***	2	3 *	4	5
			1						3				
A^2		Amount	0	1 *	2	3	4	5					
		How Well	0	1	2	3 *	4	5	1 **	2	3 *	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 10
Item Number: 10 (Wash hands)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			4						0				
A^1	Amount		0	1	2 ***	3	4 *	5					
		How Well	0	1	2 *	3 ***	4	5	1	2	3	4	5
			4						0				
B	Amount		0	1	2	3	4	5					
		How Well	0	1	2 *	3 ***	4	5	1	2	3	4	5
			4						0				
A^2	Amount		0	1	2	3 **	4 **	5					
		How Well	0	1	2	3 ***	4 *	5	1	2	3	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 11
Item Number: 11 (Dry hands)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			4						0				
A^1	Amount		0	1	2 **	3 *	4 *	5					
	How Well		0	1	2 ***	3 *	4	5	1	2	3	4	5
			4						0				
B	Amount		0	1	2	3	4	5					
	How Well		0	1	2 *	3 ***	4	5	1	2	3	4	5
			4						0				
A^2	Amount		0	1	2	3 **	4 **	5					
	How Well		0	1	2	3 ***	4 *	5	1	2	3	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 12
Item Number: 12 (Put on socks)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses					
			2						**2**					
A¹	Amount		0	1	2 **	3	4	5						
	How Well		0	1	2 **	3	4	5	1	2 **	3	4	5	
			0						**4**					
B	Amount		0	1	2	3	4	5						
	How Well		0	1	2	3	4	5	1	2 ****	3	4	5	
			0						**4**					
A²	Amount		0	1	2	3	4	5						
	How Well		0	1	2	3	4	5	1	2 ****	3	4	5	

[a]Study phase A¹ represents the pretest, B represents the treatment, and A² represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 13
Item Number: 13 (Take off socks)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			3						1				
A^1	Amount		0	1 *	2 **	3	4	5					
		How Well	0	1 *	2 **	3	4	5	1 *	2	3	4	5
			0						4				
B	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1 *	2 ***	3	4	5
			0						4				
A^2	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1	2 ****	3	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 14
Item Number: 14 (Put on shoes)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			2						**2**				
A^1	Amount		0	1	2 **	3	4	5					
		How Well	0	1 *	2 *	3	4	5	1 *	2 *	3	4	5
			0						**4**				
B	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1	2 ****	3	4	5
			0						**4**				
A^2	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1	2 ****	3	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 15
Item Number: 15 (Take off shoes)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			3						1				
A^1	Amount		0	1	2 ***	3	4	5					
		How Well	0	1 *	2 *	3	4	5	1	2	3	4	5 *
			0						4				
B	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1	2 ***	3	4	5 *
			0						4				
A^2	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1	2 ****	3	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 16
Item Number: 16 (Get up from chair with armrests)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			4						0				
A^1	Amount		0	1	2 ***	3 *	4	5					
	How Well		0	1 *	2 ***	3	4	5	1	2	3	4	5
			2						2				
B	Amount		0	1	2	3	4	5					
	How Well		0	1 *	2	3 *	4	5	1 **	2	3	4	5
			3						1				
A^2	Amount		0	1 ***	2	3	4	5					
	How Well		0	1 *	2 *	3	4	5	1 *	2	3	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 17
Item Number: 17 (Pull chair away from table before sitting down)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			0						4				
A^1	Amount		0	1	2	3	4	5					
	How Well		0	1	2	3	4	5	1	2	3 ****	4	5
			0						4				
B	Amount		0	1	2	3	4	5					
	How Well		0	1	2	3	4	5	1	2	3 ****	4	5
			0						4				
A^2	Amount		0	1	2	3	4	5					
	How Well		0	1	2	3	4	5	1	2	3 ****	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 18
Item Number: 18 (Pull chair towards table after sitting down)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			2						**2**				
A[1]	Amount		0	1 **	2	3	4	5					
		How Well	0	1	2 **	3	4	5	1 *	2	3 *	4	5
			0						**4**				
B	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1 ****	2	3	4	5
			1						**3**				
A[2]	Amount		0	1	2 *	3	4	5					
		How Well	0	1	2 *	3	4	5	1 ***	2	3	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 19
Item Number: 19 (Pick up glass)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			0						4				
A^1	Amount		0	1	2	3	4	5					
	How Well		0	1	2	3	4	5	1 ****	2	3	4	5
			2						2				
B	Amount		0	1	2	3	4	5					
	How Well		0	1	2	3 **	4	5	1 **	2	3	4	5
			4						0				
A^2	Amount		0	1 *	2	3 **	4 *	5					
	How Well		0	1	2 *	3 ***	4	5	1	2	3	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 20
Item Number: 20 (Brush your teeth)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			0						4				
A^1	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1 ****	2	3	4	5
			2						2				
B	Amount		0	1	2	3	4	5					
		How Well	0	1	2 *	3 *	4	5	1 **	2	3	4	5
			0						4				
A^2	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1 ****	2	3	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 21
Item Number: 21 (Shave)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			0						4				
A^1	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1 ****	2	3	4	5
			1						3				
B	Amount		0	1	2	3	4	5					
		How Well	0	1	2 *	3	4	5	1 **	2	3	4 *	5
			2						2				
A^2	Amount		0	1 *	2 *	3	4	5					
		How Well	0	1	2	3 *	4 *	5	1 *	2	3	4 *	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 22
Item Number: 22 (Use a key to open a door)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			0						**4**				
A^1	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1	2	3 ****	4	5
			0						**4**				
B	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1	2	3 ***	4 *	5
			0						**4**				
A^2	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1	2	3 ***	4 *	5

[a]Treatment phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 23
Item Number: 23 (Write on paper, or stabilize paper with non-dominant hand)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			4						0				
A^1	Amount		0	1	2 *	3	4 **	5 *					
		How Well	0	1	2	3	4 ***	5 *	1	2	3	4	5
			1						3				
B	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4 *	5	1 *	2	3	4 **	5
			0						4				
A^2	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1	2	3 *	4 ***	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 24
Item Number: 24 (Steady self while standing)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			3						1				
A^1	Amount		0	1 *	2 **	3	4	5					
		How Well	0	1 **	2 *	3	4	5	1 *	2	3	4	5
			3						1				
B		Amount	0	1	2	3	4	5					
		How Well	0	1 *	2 **	3	4	5	1 *	2	3	4	5
			4						0				
A^2	Amount		0	1 **	2 **	3	4	5					
		How Well	0	1	2 *	3 **	4 *	5	1	2	3	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 25
Item Number: 25 (Carry object from place to place)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			1						3				
A^1	Amount		0	1	2 *	3	4	5					
		How Well	0	1	2 *	3	4	5	1	2	3	4 ***	5 *
			2						2				
B	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3 *	4 *	5	1 *	2 *	3	4	5
			0						4				
A^2	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1 ****	2	3	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 26
Item Number: 26 (Use fork or spoon to eat)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			3						1				
A^1	Amount		0	1 *	2 **	3	4	5					
		How Well	0	1 *	2 **	3	4	5	1 *	2	3	4	5
			3						1				
B		Amount	0	1	2	3	4	5					
		How Well	0	1	2	3 ***	4	5	1 *	2	3	4	5
			4						0				
A^2	Amount		0	1 *	2 **	3 *	4	5					
		How Well	0	1	2 **	3 **	4	5	1	2	3	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 27
Item Number: 27 (Comb hair)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			0						4				
A^1	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1 ****	2	3	4	5
			0						4				
B	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1 ****	2	3	4	5
			0						4				
A^2	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1 ****	2	3	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 28
Item Number: 28 (Pick up a cup by a handle)

		Number of "Yes" Responses						Number of "No" Responses				
		0						4				
A^1	Amount	0	1	2	3	4	5					
	How Well	0	1	2	3	4	5	1 ****	2	3	4	5
		1						3				
B	Amount	0	1	2	3	4	5					
	How Well	0	1	2	3	4 *	5	1 *	2	3	4 **	5
		1						3				
A^2	Amount	0	1 *	2	3	4	5					
	How Well	0	1	2	3	4 *	5	1 ***	2	3	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 29
Item Number: 29 (Button a shirt)

Study Phase[a]			Number of "Yes" Responses						Number of "No" Responses				
			0						4				
A^1	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1 ****	2	3	4	5
			2						2				
B	Amount		0	1	2	3	4	5					
		How Well	0	1 **	2	3	4	5	1 **	2	3	4	5
			0						4				
A^2	Amount		0	1	2	3	4	5					
		How Well	0	1	2	3	4	5	1 *	2 ***	3	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

Table 30
Item Number: 30 (Eat half a sandwich or finger foods)

Study Phase[a]		Number of "Yes" Responses						Number of "No" Responses				
		0						**4**				
A^1	Amount	0	1	2	3	4	5					
	How Well	0	1	2	3	4	5	1 **	2	3 **	4	5
		2						**2**				
B	Amount	0	1	2	3	4	5					
	How Well	0	1	2	3 **	4	5	1	2	3 *	4 *	5
		2						**2**				
A^2	Amount	0	1 *	2	3 *	4	5					
	How Well	0	1 *	2	3	4 *	5	1 *	2	3 *	4	5

[a]Study phase A^1 represents the pretest, B represents the treatment, and A^2 represents the post-test phase.
The frequency of responses of each scale ratings are indicated by the number of *'s shown.

APPENDIX B

APPENDIX B: TREATMENT DESCRIPTION

The subject arrived, as scheduled on February 5, however, he presented with a cold and it was evident he was not feeling well. Once up in the clinic, the subject was provided with a modified standard sling. A piece of fabric was sewed onto the open end to support and prevent use of his right hand. The subject was able to demonstrate the ability to doff the sling, however, needed assistance to don it properly.

One half of the MAL was then administered, followed by initial design and construction of a leather wallet. The subject chose to construct a tri-fold leather wallet. Construction of this wallet entails:

1. Choosing a design for the wallet
2. Wetting the leather with a sponge and tracing an indented design onto the leather.
3. Using a swivel knife to cut the leather on the lines.
4. Using a mallet and metal tools to create the design on the leather.
5. Staining or sealing the leather
6. Stitching the wallet together.

Most of these components require bilateral hand use to work with and stabilize the project. To prevent excessive use of the right hand from participating (through the sling), a vice was used to hold the leather, and assistance was given by the primary researcher to enable the subject to use only his involved upper extremity. Many small breaks were needed throughout the project. During these breaks, the sling continued to be worn.

A break was provided at 11:00, during which coffee and muffins were

provided. The subject used his involved extremity to consume the refreshments, however, would occasionally attempt to assist with his right extremity through the sling.

At 11:15, the subject was given a choice of board games to play. The game of "Connect Four" was engaged in until lunchtime. The subject used his left upper extremity to place all of the game pieces in the overhead slots.

Lunch was scheduled at noon. On this first day, the subject was given the opportunity to use his uninvolved extremity to feed himself, as he appeared tired and somewhat ill. The subject was observed to use his right upper extremity entirely to eat. After he was finished eating, the sling was put back on his right upper extremity.

At 1:00, simple ADL tasks such as grooming were engaged in using only his involved extremity. Verbal cues were given to not attempt to assist with his right upper extremity. Following these tasks, assembly of a model car was begun. Pieces of the car could be assembled by simply snapping them together. For step two, however, a small screwdriver was needed and this activity was postponed, since a screwdriver was unavailable.

For the remainder of the time, construction of the leather wallet was used as treatment. The subject attempted to use his right hand through the sling occasionally and was given verbal cues to use his left hand only.

Transportation for the subject was called early, as the subject's energy level had decreased secondary to his illness. His frustration level appeared to have increased and he requested to leave so he could rest.

Secondary to his illness, the subject was unable to take part in treatment for

the remainder of the week.

Monday, February 12

9:15 – The subject arrived. The WMFT, 9HPT, and ½ of MAL were administered

10:20 – A rest break was provided. The sling was continued to be worn. The subject used his left upper extremity to consume all refreshments.

10:30 – The subject began construction of the leather wallet. The subject alternates holding metal piece and mallet with left hand while primary researcher offers assistance to hold metal piece while subject uses mallet. The subject attempts to reposition the mallet with his right hand, through the sling.

11:15 – A rest break was provided. The subject requests to use bathroom, at which time the sling is taken off for safety purposes.

11:30 – The game of "Connect Four" was engaged in with the subject. He used his left hand approximately 90% of attempts to place game pieces. The sling does not completely restrain the use of the right extremity.

12:20 – A lunch break is taken. The subject was instructed to eat as much as possible while wearing the sling. The subject ate approximately half of the lunch with the restraint donned.

1:15 – The subject continued construction of leather wallet. The project is completed in the same manner as stated above.

2:00 – Break

2:15 – Engaged in game of "Connect Four". The subject used his left hand entirely for game piece placement.

2:45 – Clean up from the days activities. The subject assisted in putting away supplies with his left extremity. The subject stated that he was tired and planed to rest when he returned home.

Tuesday, February 13

9:15 – The subject arrived with sling donned.

9:45 – The subject began model car assembly. He used his left hand to manipulate the screwdriver. Shortly into the task, the subject reported feeling left leg numbness. The subject was assisted in a stand pivot transfer to an alternate chair to attempt to relive pressure on leg. Furthermore, the subject's left leg AFO (ankle foot orthosis) is taken off to relieve pressure on leg. The numbness persisted and was very bothersome to subject. The primary researcher contacted the subject's nurse by telephone, who recommended taking the subject's blood pressure (108/60) and to feel the temperature of both beet. The subject's feet felt equally warm. The subject continued on with the project while his condition was continued to be monitored.

10:35 – The subject reported that his left leg was feeling better. The subject's shoes are put back on his feet, however, the AFO is left off. The previous activity was resumed.

11:00 – A break was taken from the activity. The subject consumed refreshments with his left upper extremity. Minimum assistance is provided with drinking a cup of coffee to prevent spilling.

11:15 – The subject is engaged in game of "Connect Four". The subject used left upper extremity for 100% of game piece placement.

12:00 – A bathroom break was taken with the sling off. This break was followed by lunch. The subject consumed all of his lunch with the sling on. Given the opportunity to doff sling midway through lunch, the subject stated "I want to beat this thing" and wished to keep the sling on. The subject reported no more complaints of leg numbness.

1:15 – The subject continued with construction of the leather wallet. Approximately 15 minutes into project, the subject appeared to have increased fatigue from using mallet. The project is stopped, and the subject is engaged in a card game. The subject used his left hand for card manipulation.

2:45 – Clean up of days activities. The client is escorted outside to wait for transportation to arrive to take him back to the nursing home.

5:30 – The nursing home is contacted via telephone by the primary researcher to discuss the sling wearing schedule outside of treatment time. The nursing staff was asked to help the subject remember to wear the sling during the afternoon and nighttime hours.

Wednesday, February 14

8:45 – The subject arrived with a lunch and photographs to construct a scrapbook. The sling was worn on the subject's left arm (incorrect extremity). The subject did not appear to be aware that it was on the incorrect arm. Once in clinic, the subject reported increased discomfort in his left leg, secondary to a "lump" on his gluteal region. The subject is repositioned in his chair with increased padding to help alleviate his discomfort.

9:30 – Attempted to administer the MAL. The client stated that he is feeling

increased discomfort, rating his pain as an 8 on a scale of 10. The subject reported that the pain is shooting down his leg, with numbness. The subject was transferred to a supine position on plinth. The subject's condition was discussed with an occupational therapist in the clinic. It was determined that the subject should return to his nursing home for an evaluation by nursing.

10:30 – The subject was escorted outside to wait for transportation. His nursing home was contacted about his condition.

Wednesday, February 15 – 18

The subject is temporarily discontinued from treatment secondary to his pain. A discussion is held with the subject to determine what changes will facilitate success in completion of this study. A decision was made to continue treatment at his nursing home beginning on the following Monday.

Monday, February 19

8:30 – The researcher arrived at the subject's nursing home. The treatment room is set up.

9:00 – The subject arrived in the treatment room. The sling is donned. The WMFT and Geriatric Depression Scale (GDS) are administered. The subject scored a 17 on GDS, suggesting a mild depressive state. The subject demonstrated decreased tolerance for sitting at this time and needed to reposition himself often.

10:30 – The subject begins leather wallet construction.

10:40 – The subject requested to use the bathroom; the sling is doffed for

safety purposes.

11:00 – A card game is begun with the subject. The subject uses his left hand entirely.

11:40 – Break

11:45 – The card game is continued.

12:15 – The subject reported increased fatigue and requested to rest in his room. The sling is taken off.

1:00 – The subject was woken up. The sling is donned and the subject is then engaged in a game of checkers. The left extremity is used entirely.

1:15 – Lunch arrived and the subject ate a portion of his lunch with his left extremity. While attempting to drink, the subject dropped the cup and became frustrated. The remainder of lunch was consumed with the sling off and his left hand is used as an assist.

1:40 – The subject requested to continue with the game of checkers. The sling was donned. The subject used his left hand to move the game pieces however his right hand was used through the sling to support his head and reposition himself in the chair. The subject showed an increased difficulty with moving pieces as the game progressed and the game pieces became positioned further away on the board. The subject appeared to have decreased discomfort in the afternoon while engaged in game of checkers.

3:00 – End of the day. The subject was reminded to continue to wear the sling for the remainder of the day and complete most activities with his left upper extremity.

Tuesday, February 20

9:00 – The subject was brought to the treatment room. The WMFT and 9HPT were administered, followed by a brief break and administration of MAL.

10:10 – The sling was doffed for a bathroom break.

10:15 – The sling was donned and a game of "Connect Four" was engaged in. The subject used his left extremity to sort checkers on board. All checkers were moved with his left hand, however his right hand is used for postural support and assistance with weight shifting.

10:45 – The subject reported increased discomfort in left leg and requested Tylenol from nursing.

11:00 – Treatment was switched to the subject's room. The subject reported continued discomfort. Treatment was engaged in until approximately 11:35, at which time the resident requested to lie down and rest.

11:35 – The sling is doffed and the subject is assisted onto his bed for a rest.

12:10 – The subject is awoken. The sling is donned, and treatment activities were resumed.

12:45 – Lunch arrived. The subject consumed approximately 30% with his left extremity. The subject demonstrated increased frustration as food frequently fell off of the eating utensils. The sling is taken off, and the remainder of lunch was consumed with his right hand.

1:10 – The subject requested to engage in the game of "Connect Four". The subject appeared to demonstrate an increased ability to place game pieces accurately. The subject used his left extremity for 100% of the activity.

1:30 – The subject requested to use the bathroom. The sling is doffed.

1:45 – The subject is assisted in donning jacket. The subject is taken outside to fill bird feeders around nursing home. The subject demonstrated the ability to twist the cap off of a 1-gallon milk jug to pour out birdseed. The subject held a foam cup, while birdseed was poured into it.

2:10 – The subject is engaged in a game of cards. The subject demonstrated the ability to hold and manipulate the cards with his left hand

2:45 – The subject demonstrated an increased level of frustration with his left extremity and requested to rest.

3:00 – End of the day. The subject was assisted to his bed for rest.

Wednesday, February 21

9:00 –The 9HPT is administered. The subject stated that he felt increased pressure in his forehead region. Nursing was notified. Nursing stated that his medication should help to decrease the feeling of pressure in his head. The WMFT was then administered. The subject reported discomfort in left leg following the assessment.

9:50 – The subject requested to lie down. The MAL was administrated while the subject was supine in bed.

10:10 – The subject was assisted back into his wheelchair. The game of "Connect Four" was the engaged in. The subject sorted all the game pieces by color and placed them using his left extremity.

10:35 – The subject requested Tylenol from nursing for his pain.

10:40 – The subject was engaged in checkers with small breaks until

lunchtime.

11:30 – End of day (secondary to schedule conflict)

Thursday, February 22

9:00 – The subject was in bed upon arrival, not dressed or ready for the day. The subject reported increased discomfort and pain in left leg. Nursing staff state they are scheduling the subject to be evaluated for possible hip fracture.

1:30 – Contacted the nursing home via telephone. The subject was waiting for results from x-ray.

7:00 - Contacted the nursing home via telephone. The subject was to be scheduled for an MRI of left leg and gluteal region.

Friday, February 23

No treatment secondary to schedule conflict

Saturday, February 24

9:00 – The subject requested a short rest in bed prior to beginning the day.

9:20 – Administered the WMFT. The subject reported increased pain in leg and requested to lie down.

9:40 – Administered the MAL while the subject was supine in bed.

10:00 – Administer the 9HPT.

10:10 – Engaged in game of "Connect Four". The subject sorted and placed all pieces with left hand.

10:40 – Continued with leather wallet construction. The subject used his left extremity for most subtasks.

11:10 – Relocated treatment into the subject's room at his request. Engaged

in a game of checkers. Two games were played for which the subject used his left extremity for all moves.

11:55 – The subject had increased complaints of pain in left leg. The subject then requested to rest; break for lunch.

12:45 – The subject was awoken and lunch arrived. The sling is donned, and the subject was given verbal cues to use only his left extremity. His frustration level increased with decreased effectiveness of his left hand function.

1:15 – Engage the subject in the game of "Jenga". The subject removed blocks with his left hand, with minimum assistance from researcher. The subject successfully removed and stacked 12 blocks.

1:50 – The subject requested to use the bathroom. The sling is taken off.

2:00 – A card game is engaged in. The subject primarily used his left hand to manipulate the cards. Minimum assistance was provided with his right hand through the sling. Verbal cues were given to only use his left hand.

2:50 – Increased discomfort was reported in the subject's leg, at which time he requested to rest in bed.

3:00 – End of the day.

Sunday, February 25

9:00 – The subject was in bed upon arrival.

9:25 – Administration of the 9HPT and the WMFT. The subject demonstrated an increased tolerance for sitting

10:10 – Engaged in modified game of Jenga. The subject used his left hand to

remove and place blocks.

10:40 – Break; subject request to lie down.

10:50 – Continued with game of "Jenga". The subject occasionally used a pen in left hand to displace blocks. Minimum assistance was given with his right hand through sling to reposition blocks in left hand.

11:30 – The subject requested to lie down. During this time, the MAL was administered.

12:00 – The subject requests to take a break for a nap.

12:55 – The subject is awoken. Engaged the subject in a game of "Connect Four".

1:40 – Lunch arrived. The subject consumed approximately 20% of lunch with his left hand.

2:10 – Begin construction of photograph scrapbook. The subject demonstrated difficulty manipulating pictures and paper. The subject soon lost interest in the project and it was then discontinued.

3:00 – End of the day.

Monday, February 26

9:00 – The researcher arrived and began a game of "Connect Four" with the subject. The subject sorted game pieces and played entire game with left hand.

9:35 – Administered the WMFT and the 9HPT.

10:00 – Continued construction on the leather wallet. The leather was clamped to table top enabling the subject to use only his left hand.

10:30 – Watered plants in the treatment room. The subject held the watering pot in his left hand with minimum assistance provided by the researcher to prevent spilling.

10:45 – Continued to assemble the wooden birdhouse. The subject was able to apply glue to the wood with his left hand. Assistance was needed to begin tacking small nails into the wood. Using hammer proved to be difficult for the subject, since he was right hand dominant.

11:45 – Engaged the subject in a game of "Connect Four", while the glue on the birdhouse was drying.

12:00 – The subject was then taken to his room for a short nap.

12:30 – The subject was then taken to the dining room for lunch with other residents. Observation showed that the subject consumed food with his right hand primarily.

1:10 – Engaged the subject in a simple peg placing game. The subject was able to grasp and release small metal pegs into holes with minimum to moderate difficulty.

1:45 – Engaged in two games of checkers. The subject used his left hand to move game pieces.

2:30 – The subject requested to take a rest break. He was then taken back to his room for administration of the MAL.

3:00 – End of the day.

Tuesday, February 27

9:00 – Arrive; administer the 9HPT and the WMFT. The subject reported that

his left hand felt cold that morning, and therefore did not function as he had wanted.

10:05 – Began assembly of the birdhouse. The subject used his left hand to drive nails into the wood. The hammering continued to create increased frustration secondary to its difficulty. The subject requested to take a break. The MAL was then administered.

10:40 – Continued nailing the birdhouse together. Began applying stain to the wood. The subject used his left hand for both tasks. The subject stated, "this is tough" in regards to staining wood.

11:40 – Lunch break was longer on this date secondary to a schedule conflict

1:00 – Following lunch, the subject was side lying in bed, stating that he did not feel well. Lunch arrived, however the subject refused to eat. The subject requested to continue resting.

1:30 – The subject stated he was feeling better and agreed to participate. He was then brought to the activity room. Continued staining the birdhouse with his left hand.

2:45 – The subject began demonstrating increased frustration and fatigue. End of the day.

Wednesday, February 28

9:00 – Upon arrival the subject was still in bed in his pajamas. Nursing reported that the subject had a doctor's appointment and would be departing at approximately 10:30am. Testing was therefore not possible on this day secondary to a shortness of time. Instead of the typical daily routine, the

subject was assisted with his morning tasks of getting washed, dressed, and groomed. The sling was not worn for safety purposes, however an increased emphasis was placed on using his left extremity for all tasks. Occasional verbal cues were needed to use left extremity for tasks. Washing and grooming were completed primarily with his left hand, however dressing tasks were completed with both hands.

10:30 – The subject departed the nursing home for his pre scheduled doctor's appointment.

Thursday, March 1

9:00 – The subject attempted to don his sling independently, however needed minimum assistance fastening the strap. The subject was then taken to the testing room for administration of the 9HPT and the WMFT.

9:45 – A game of checkers was engaged in and completed using his left hand entirely.

10:30 – A rest break was provided with the sling off.

10:40 – The subject requested to play a game of "Connect Four". The subject sorted game pieces by color with his left hand. Increased levels of fatigue and frustration were noted, and subject stated, "my hand isn't working well". A rest break was then requested.

10:45 – The MAL was administered.

11:05 – The subject was assisted to bathroom with the sling off.

11:15 – Continued treatment with two games of "Connect Four".

11:55 – Rest break

12:40 – Lunch arrived, the subject used his left hand for approximately 50% of lunch consumption.

1:25 – The subject requested to continue with staining of the birdhouse. Periodic rest breaks were provided to prevent excessive frustration and fatigue.

2:20 – Engaged the subject in a card game. The subject used a cardholder to hold the cards instead of his right hand and manipulated the cards with left hand.

3:00 – End of the day

Friday, March 2

No treatment secondary to schedule conflict.

Saturday, March 3

10:00 – Researcher arrived; the subject was up and prepared for day. The 9HPT and the WMFT were then administered. The subject stated, "my hand is slightly cold today".

10:45 – Engaged the subject in two games of "Connect Four". The subject used his left hand entirely. Movements appeared to be slower and with decreased accuracy. The subject further reported increased discomfort in his left lower extremity and buttock region.

11:30 – The subject requested to take a rest break and needed pain medication from nursing. The MAL was then administered with subject supine in bed.

11:45 – Engaged in two games of checkers. The subject continued to report

discomfort in leg; nursing was then notified.

12:30 – The subject was then taken to the cafeteria for lunch with the sling on. The subject ate most of his lunch with the left extremity.

1:00 – The subject's discomfort increased to the point that a rest break was required. The subject was then taken back to hi room for a nap.

1:15 – End of day.

Sunday, March 4

1:00 – Arrived to the nursing home, no testing was conducted secondary to the shortened treatment session. Six sides of the birdhouse were glued and nailed together. The subject used his left hand primarily, with minimum assistance given. Verbal cues were needed not to use his right hand through the sling. Periodic rest breaks were provided to prevent excessive fatigue and frustration.

3:45 – End of the day

Monday, March 5

9:00 – The subject is awake and up in his room, however has not yet received his morning medication.

9:45 – The subject was then brought up to the activity room for administration of the 9HPT and the WMFT.

10:10 – A game of Monopoly is begun upon the subject's request.

12:00 – The subject requests a rest break, and is then taken to his room with the sling off for a rest.

1:00 – Lunch arrived to subject's room. Verbal cues were needed to remind

the subject to use only left hand.

1:20 – Continued with the game of Monopoly. The subject used his left hand to roll the dice and move the game pieces, sort money and draw cards.

2:40 – Rest break provided, during which the MAL is administered.

3:05 – End of the day.

Tuesday, March 6

9:00 – Arrive. Discussed briefly the subject's status with other professionals as his care conference is scheduled for 10:00.

9:25 – Administered the 9HPT and the WMFT.

10:00 – Attended the subject's care conference along with the subject.

10:55 – The subject is engaged in activity of watering plants in activity room with both hands, verbal cues are provided to increase use of left hand. Engaged in one game of "Connect Four" and one game of Checkers. After approximately one half hour, the subject reported increased discomfort in leg and buttock region and requested a rest break.

11:55 – The subject was taken back to his room for a rest, will await arrival of lunch.

12:30 – Lunch arrived and the subject consumes approximately half of lunch with left hand.

1:00 – Administer the Geriatric Depression Index. The subject scored a 13 indicating mild depressive symptoms.

1:30 – Began a game of Monopoly. The subject used his left hand to manipulate all game pieces.

2:50 – Increased discomfort in left lower extremity reported. The subject requested his pain medication from nursing and a rest break.

3:00 – End of the day.

APPENDIX C

APPENDIX C: HUMAN SUBJECTS PROPOSAL

1. General Information about the Study

a. **Funding:** The Occupational Therapy Department at Ithaca College will provide all necessary supplies throughout the course of treatment. The participant will not be asked to pay for any supplies, and the treatment will be free of charge.

b. **Location**: The pre-test, post-test and experimental treatment will be conducted in the Occupational and Physical Therapy clinic at Ithaca College.

c. **Time Period:** The pre-test will be administered twice per week for two weeks starting January 8th, 2000. The treatment will begin on January 22nd and continue daily for 14 days. Post-test data will be collected twice per week for two weeks beginning on February 5h.

2. Related Experience of the Researcher

The primary researcher has earned a B.S. in Occupational Science and is an M.S. candidate in Occupational Therapy. Research and statistical analysis experience of the primary researcher includes the following courses: Biostatistics (670-39000), Research Seminar (672-49500), and Research Methods (672-67000). The primary researcher has performed a comprehensive literature review on constraint-induced movement therapy and has presented an in-service to the rehabilitation staff at Fairbanks Memorial Hospital in Fairbanks, Alaska regarding this treatment.

Professor Diane Long has thoroughly researched constraint-induced therapy. She recently designed and implemented a study to measure the results of constraint-induced therapy in a single subject design. Professor and Chair of the Ithaca College Occupational Therapy department, Dr. Catherine Gordon, assisted Professor Long in data analysis of the same study. Dr. Gordon has experience in stroke rehabilitation and research supervision. Professor Kathy Stoklosa has been a practicing therapist for over 12 years working in both inpatient and outpatient stroke rehabilitation. She has worked closely with the Neurology Department at Strong Memorial Hospital and with a comprehensive team at Rochester Rehabilitation Center in Rochester, NY in efforts to improve stroke rehabilitation programs. Furthermore, Professor Stoklosa assisted Professor Long with qualitative analysis of data gathered in her study.

3. Benefits of the Study

In recent studies, constraint-induced movement therapy has been shown to increase functional use of the involved upper-extremity in chronic stroke patients. If a chronic stroke patient meets specific motor criteria, the amount of time since the stroke does not affect the outcome of treatment. If this study is successful, the participants are likely to increase functional use of his/her involved upper extremity. In addition to physical benefits, the participant's emotional state may also improve with the increased interaction during therapy, however this will not

be measured.

4. Description of Subjects

a. Two subjects will be recruited to engage in constraint-induced movement therapy.
b. Each subject will demonstrate the following characteristics to qualify for participation:
   - At least one year since CVA (stroke) with resultant hemiparesis.
   - 20° of active wrist extension in involved side.
   - 10° of active metacarpal-phalangeal (MCP) extension in digits 2-5 in the involved side.
   - Be over the age of 18.
   - Score at least 24 on Mini-Mental Status Exam.
   - Independent with toilet transfers for safety purposes.
   - Able to maintain standing balance for 2 minutes (with UE support).
   - Not participating in any additional experimental treatment.

5. Description of Subject Participation

The subjects receiving constraint-induced movement therapy will be asked to participate in treatment for 14 consecutive days, for 6 hours per day. The primary researcher will be providing treatment under the supervision of a certified occupational therapist. Should the primary researcher become incapable of providing treatment, a certified occupational therapist will continue treatment.

The subjects will be asked to be available for pre-test and post-test administration 2 weeks prior to, and 2 weeks following the treatment phase. During these phases, the Nine-Hole Peg Test, The Motor Activity Log and The Wolf Motor Function Test will be administered. In the initial pretest session the subjects will be asked to complete the Leisure Occupations Interest Inventory (LOII), which will be used to develop treatment activities.

The treatment phase will be comprised of activities based upon information gathered from the LOII. During the six hours of treatment, each subject will be engaged in activities of interest that require an increased level of control in the affected extremity. For safety purposes, activities will be primarily completed while sitting. If the subject must stand to complete an activity, he or she will be provided with close supervision. Treatment activities may consist of activities such as crafts, exercise, and cooking. Specific activities cannot be determined at this time since each activity will be developed based on the interests of the subjects. Once the interests are determined, a schedule of activities will be created and given to the subjects to decrease anxiety between sessions.

One activity will be chosen for the subjects to engage in each day during the treatment. The subjects will be videotaped completing this activity in each session. The use of videotape will provide information about the quality of movement. Through analysis of this video, changes can be observed throughout the treatment phase.

Throughout treatment, both subjects will be asked to wear a resting hand splint and sling on his/her unaffected side for 90% of waking hours. For safety purposes, the subjects will be asked to remove this device while toileting, eating, sleeping, and engaging in balance-compromising activities.

6. Ethical Issues and Risks of Participation

a. The use of a device to restrain the less involved extremity may produce an increased risk for physical harm. The loss of use of that extremity during the treatment session will prevent the subject from using that arm to assist in balance compromising activities. Creating inclusionary criteria to ensure good balance in both subjects has decreased the chance of physical harm. Furthermore, the activities engaged in by each subject will be primarily completed while sitting down. Should the subject need to complete a task while standing, the researcher will be within five feet of him or her.

b. Subjects will be encouraged to use their affected extremity a great deal during this study. As a result, there is a possibility for a repetitive stress injury to develop. To decrease the likelihood of injury, subjects will be routinely asked if they are experiencing any pain, numbness, tingling, pressure or discomfort of any kind. Should a symptom such as the above occur, treatment will be terminated until it is determined safe to proceed.

c. Participating in this study demands a great deal of time by each subject. As a result, the chance that a subject will not complete this study in its entirety is increased. Should a subject be forced to withdraw during the study, it is expected that he/she will not benefit from the treatment. As a result, the subject may experience psychological or emotional distress.

d. The idea of this type of treatment causes one to think about ethical issues involved with physical constraint being applied for many hours. A device consisting of a sling and a splint will be designed for each subject. This constraint, however, will primarily serve as a physical and visual reminder for the subject while completing activities. This device is not a restraint by definition, because the client will be informed about how to don and doff the splint and sling.

7. Recruitment of Subjects

a. **Recruitment Procedures:** The subjects will be recruited from one of the following locations: the cities or surrounding areas of Binghamton, Ithaca, or Rochester. Subjects will be notified of this research opportunity by occupational therapy professors employed by Ithaca College. If interested, the subject will be contacted by telephone by the primary researcher for a further description of the research study. Upon agreement, the subjects will be seen for an initial assessment to determine if he/she meets the inclusionary criteria. Subjects who do

not meet this criteria will be not be asked to participate and debriefed regarding the reason. Should a participating subject be from an area other than Ithaca, special arrangements will be made with a caregiver or significant other regarding transportation.

b. **Inducement to Participate:** There is no monetary inducement to participate in this study. Subjects may, however, perceive the possible benefits of this study as an incentive to participate.

8. Confidentiality of Responses

To ensure confidentiality, the collected data will be kept in a locked filing cabinet in the Ithaca College Occupational and Physical Therapy clinic. Videotapes will be labeled as "Subject A" and "Subject B" and by date, and kept in the same locked filing cabinet when not being viewed. No personal information will be disclosed when analyzing the videotaped sessions. Should there be any identifying information once the data is collected, it will be destroyed. The subjects will be asked to not write their names on any forms. Following data analysis of the videotapes, the tapes will be destroyed.

9. Debriefing

Following the post-test, a meeting will be held with the subjects to discuss the study. The purpose of the study will be discussed again and any questions will be answered. Since deception is not involved in this study, a specific debriefing statement does not need to be developed.

10. Compensatory Follow-up

The subjects will be referred to their physician if any physical harm results from engaging in this study. Should the subject sustain physical harm that demands immediate care, Cayuga Medical Center and/or the Ithaca College Health Center will be contacted for assistance.

Summary of Required Appendices Attachments

A. Recruitment Statement
B. Informed Consent Form

Recruitment Statement

Hello, my name is Simon Carson and I'm an Ithaca College Graduate student. I'm conducting research for my Masters Thesis in Occupational Therapy. My study has been designed to look at the benefit of constraint-induced movement therapy among the chronic stroke population.

Constraint-induced movement therapy is a type of treatment technique used to increase functional use in the involved extremity. For two weeks, participants receive therapy for 6 hours per day while wearing a splint and sling on the unaffected extremity. Studies have shown that this treatment increases the functional use of the involved extremity of stroke patients who demonstrate minimal wrist and hand movement. Past studies typically used rote exercise as the primary treatment technique.

My research is different, in that instead of being engaged in rote exercise, activities that are of interest to you will be used, though may be altered slightly. If you agree to participate you will be asked to attend four pretest and four posttest assessment sessions, two weeks prior to and following treatment. During the first pretest, an interest inventory will be administered to determine activities that are of primary interest to you. Three additional assessments will be administered during each session of the pretest and post-test phases. These assessments include: The Nine-Hole Peg Test, The Motor Activity Log and The Wolf Motor Function Test. These assessments have been developed to assess how much movement you have in your affected extremity. The assessments in the pre-test will be administered twice per week starting January 8th. Post-test data will be collected twice per week beginning on February 5th. It is anticipated that the pre and post-test sessions will last no longer than 1 hour each. The treatment phase will begin on January 22nd and continue for 14 consecutive days.

If you agree to participate and meet the criteria outlined for this study, you will be asked to attend treatment for six hours per day for 14 consecutive days. Furthermore, you will be asked to wear a resting hand splint and sling on your unaffected arm for 90% of waking hours, in and out of treatment. This sling and splint will be custom fit for you. During the daily treatment sessions, activities will be scheduled in half-hour blocks, with multiple rest-breaks. Activities will be chosen based upon your interests and will primarily involve the use of your involved extremity. Most activities will be completed while sitting, however, some activities may be completed standing. Supervision will always be present and close supervision will be provided when engaged in standing activities. Under direct supervision of a certified and licensed occupational therapist, I will be providing the treatment.

You will be videotaped while completing a simple activity for the last half-hour of every session. This videotape will provide the research team with valuable information about the movement in your extremity. You will be asked not to wear the sling and splint when eating, toileting or engaging in activities and compromise your balance.

Your confidentiality will be assured. You can refuse to answer any questions throughout the study and you can choose to withdraw at any time. Should you agree to participate, an initial session will be required prior to pretest administration to determine if you meet the inclusionary criteria for this study.

Inclusionary criteria that is consistent with other studies has been adopted for this study. This criteria has been established to help researchers predict who will most likely benefit from constraint-induced movement therapy. The criteria has also been established for safety purposes.

The inclusionary criteria for this study is as follows:

- At least one year since CVA (stroke) with resultant hemiplegia.
- 20° of active wrist extension in involved side.
- 10° of active metacarpal-phalangeal (MCP) extension in digits 2-5 in involved side.
- Be over the age of 18.
- Score at least 24 on Mini-Mental Status Exam.
- Independent with toilet transfers for safety purposes.
- Able to maintain standing balance for 2 minutes (with UE support).
- Not participating in any additional experimental treatment.

INFORMED CONSENT FORM

Occupation-based Constraint-Induced Movement Therapy

1. Purpose of the Study: This study is being conducted to determine if chronic stroke patients can benefit from occupation-based constraint-induced movement therapy. This study will utilize activities of interest to the subjects for treatment. Quality and quantity of movement will be assessed prior to, during and following treatment.

2. Benefits of the Study: Participants in the study may receive the following benefits: increased range of motion, increased ability to use the involved extremity in real-life situations, increased speed and accuracy of movement in the more involved side, and an increased ability to engage in bilateral motor tasks.

3. What You Will Be Asked to Do:

   If you choose to participate, you will be asked:

   - To fill out an interest inventory for treatment development prior to the treatment session.
   - To attend four, one-hour pretest sessions. During these sessions, three assessments will be administered to determine the amount of movement in your involved extremity. These assessments include: The Nine-Hole Peg Test, The Motor Activity Log and The Wolf Motor Function Test.
   - To attend 14 consecutive days of treatment. Each day of treatment will last for six hours. During the daily treatment sessions, activities will be scheduled in half-hour blocks, with multiple rest-breaks. Activities will be chosen based upon your interests and will primarily involve the use of your involved extremity. The primary researcher, Simon Carson will provide treatment under direct supervision of a licensed occupational therapist.
   - To attend four one-hour post-test sessions. During the post-test sessions, the same assessments that were used in the pretest phase will be administered.
   - To wear a custom made splint and sling on your uninvolved upper extremity for 90% of waking hours in and out of treatment.
   - Not to wear this splint and sling while using the bathroom, eating, sleeping, and engaging in balance compromising activities.
   - To be videotaped completing an activity for ½ hour per day during the treatment session. This video will provide valuable information regarding the quality of movement in your involved upper extremity during the 14 days of treatment.

4. Risks: The use of a device to restrain the less involved extremity may produce an increased risk for physical harm. The loss of use of that extremity during the treatment session may prevent you from using that arm to assist in balance compromising activities. Criteria has been developed to ensure that your balance is adequate prior to engaging in this study, therefore decreasing the chance of physical harm. Further, the activities you engage will primarily be completed while sitting down. Should you need to complete a task while standing, the researcher will be within five feet you. The device applied to your less involved extremity is not a restraint by definition.

_____

Signature and Date

You will be informed about how to apply and remove both the splint and sling. You may experience physical discomfort as a result of repetitive use of the uninvolved extremity. The researchers will monitor you for symptom development to prevent discomfort of this nature. Lastly, physical irritation may result from friction of the splint or sling against the skin. Again, this will be monitored to prevent injury.

5. If You Would Like More Information about the Study: If you would like more information about this study, either before, during, or after the study, you may contact the primary researcher, Simon Carson at (607) 272-5059 or through email at scarson5@juno.com. You may also contact the chair of my supervisory committee, Diane Long at (607) 274-3093 or through email at dlong@ithaca.edu.

6. Withdrawal from the Study: You are free to withdraw from the study at any time without penalty. Furthermore, you have the right to refuse being videotaped at anytime.

7. How the Data Will be Maintained in Confidence: All data, including written forms and videotape will be kept in complete confidence. All data will be kept in a locked filing cabinet in the Ithaca College Occupational and Physical Therapy Clinic when not being used. A member of the research group will observe the video for data analysis. Identifying information will not be made available to this person. Once the data has been collected and analyzed, all identifying information will be destroyed.

I have read the above and I understand its contents. I agree to participate in the study.

_____

Print or Type Name

_____ _____

Signature Date

I give my permission to be videotaped as stated above.

_____ _____

Signature Date

APPENDIX D

APPENDIX D: MAL SCORESHEET

EXCITe MAL

Part 1

Patient #_____ Date_____

Rater _____

1A. Turn on a light with a light switch.

_____ Yes

_____ Amount

_____ How Well

_____ No (skip to Section B)

1B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.

____ Someone else did it for me.

____ I never do that activity, with or without help from someone else.

____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.

____ Other.

2A. Open a drawer.

_____ Yes

_____ Amount

_____ How Well

_____ No (skip to Section B)

2B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.

____ Someone else did it for me.

____ I never do that activity, with or without help from someone else.

____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.

____ Other.

3A. Remove an item of clothing from a drawer

_____ Yes

_____ Amount

_____ How Well

_____ No (skip to Section B)

3B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.

____ Someone else did it for me.

____ I never do that activity, with or without help from someone else.

____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.

____ Other.

4A. Pick up a phone.

_____ Yes

_____ Amount

_____ How Well

_____ No (skip to Section B)

4B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.

____ Someone else did it for me.

____ I never do that activity, with or without help from someone else.

____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.

____ Other.

5A. Wipe off a kitchen counter or other surface

_____ Yes

_____ Amount

_____ How Well

_____ No (skip to Section B)

5B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.
____ Someone else did it for me.
____ I never do that activity, with or without help from someone else.
____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.
____ Other.

6A. Get in/ out of a car

_____ Yes
_____ Amount
_____ How Well
_____ No (skip to Section B)

6B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.
____ Someone else did it for me.
____ I never do that activity, with or without help from someone else.
____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.
____ Other.

7A. Open a refrigerator

_____ Yes
_____ Amount
_____ How Well
_____ No (skip to Section B)

7B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.
____ Someone else did it for me.
____ I never do that activity, with or without help from someone else.
____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.
____ Other.

8A. Open a door by turning a door knob

_____ Yes

_____ Amount

_____ How Well

_____ No (skip to Section B)

8B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.

____ Someone else did it for me.

____ I never do that activity, with or without help from someone else.

____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.

____ Other.

9A. Use a TV remote control unit

_____ Yes

_____ Amount

_____ How Well

_____ No (skip to Section B)

9B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.

____ Someone else did it for me.

____ I never do that activity, with or without help from someone else.

____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.

____ Other.

10A. Wash your hands

_____ Yes

_____ Amount

_____ How Well

_____ No (skip to Section B)

10B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.
____ Someone else did it for me.
____ I never do that activity, with or without help from someone else.
____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.
____ Other.

11A. Dry your hands

_____ Yes
  _____ Amount
  _____ How Well
_____ No (skip to Section B)

11B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.
____ Someone else did it for me.
____ I never do that activity, with or without help from someone else.
____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.
____ Other.

12A. Put on your socks

_____ Yes
  _____ Amount
  _____ How Well
_____ No (skip to Section B)

12B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.
____ Someone else did it for me.
____ I never do that activity, with or without help from someone else.
____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.
____ Other.

13A. Take off your socks

_____ Yes

_____ Amount

_____ How Well

_____ No (skip to Section B)

13B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.

____ Someone else did it for me.

____ I never do that activity, with or without help from someone else.

____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.

____ Other.

14A. Put on your shoes

_____ Yes

_____ Amount

_____ How Well

_____ No (skip to Section B)

14B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.

____ Someone else did it for me.

____ I never do that activity, with or without help from someone else.

____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.

____ Other.

15A. Take off your shoes

_____ Yes

_____ Amount

_____ How Well

_____ No (skip to Section B)

15B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.

____ Someone else did it for me.

____ I never do that activity, with or without help from someone else.

____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.

____ Other.

EXCITe MAL
Part 2

Patient #_____ Date_____

Rater _____

16A. **Get up from a chair with armrests**

_____ Yes
_____ Amount
_____ How Well
_____ No (skip to Section B)

16B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.
____ Someone else did it for me.
____ I never do that activity, with or without help from someone else.
____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.
____ Other.

17A. **Pull chair away from a table before sitting down.**

_____ Yes
_____ Amount
_____ How Well
_____ No (skip to Section B)

17B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.
____ Someone else did it for me.
____ I never do that activity, with or without help from someone else.
____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.
____ Other.

18A. Pull chair toward table after sitting down

_____ Yes

_____ Amount

_____ How Well

_____ No (skip to Section B)

18B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.

____ Someone else did it for me.

____ I never do that activity, with or without help from someone else.

____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.

____ Other.

19A. Pick up a glass

_____ Yes

_____ Amount

_____ How Well

_____ No (skip to Section B)

19B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.

____ Someone else did it for me.

____ I never do that activity, with or without help from someone else.

____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.

____ Other.

20A. Brush your teeth

_____ Yes

_____ Amount

_____ How Well

_____ No (skip to Section B)

20B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.
____ Someone else did it for me.
____ I never do that activity, with or without help from someone else.
____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.
____ Other.

21A. Put on makeup/shave

_____ Yes
_____ Amount
_____ How Well
_____ No (skip to Section B)

21B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.
____ Someone else did it for me.
____ I never do that activity, with or without help from someone else.
____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.
____ Other.

22A. Use a key to open a door

_____ Yes
_____ Amount
_____ How Well
_____ No (skip to Section B)

22B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.
____ Someone else did it for me.
____ I never do that activity, with or without help from someone else.
____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.
____ Other.

23A. Write on paper (if dominant arm was most affected, do you use it to write?; if nondominant arm was most affected, do you use it to stabilize the paper when writing?)

_____ Yes

_____ Amount

_____ How Well

_____ No (skip to Section B)

23B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.

____ Someone else did it for me.

____ I never do that activity, with or without help from someone else.

____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.

____ Other.

24A. Steady Yourself while standing

_____ Yes

_____ Amount

_____ How Well

_____ No (skip to Section B)

24B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.

____ Someone else did it for me.

____ I never do that activity, with or without help from someone else.

____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.

____ Other.

25A. Carry an object from place to place

_____ Yes

_____ Amount

_____ How Well

_____ No (skip to Section B)

25B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.
____ Someone else did it for me.
____ I never do that activity, with or without help from someone else.
____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.
____ Other.

26A. **Use a fork or spoon for eating**

_____ Yes
  _____ Amount
  _____ How Well
_____ No (skip to Section B)

26B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.
____ Someone else did it for me.
____ I never do that activity, with or without help from someone else.
____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.
____ Other.

27A. **Comb your hair**

_____ Yes
  _____ Amount
  _____ How Well
_____ No (skip to Section B)

27B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.
____ Someone else did it for me.
____ I never do that activity, with or without help from someone else.
____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.

____ Other.

28A. Pick up a cup by a handle

_____ Yes

_____ Amount

_____ How Well

_____ No (skip to Section B)

28B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.

____ Someone else did it for me.

____ I never do that activity, with or without help from someone else.

____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.

____ Other.

29A. Button a shirt

_____ Yes

_____ Amount

_____ How Well

_____ No (skip to Section B)

29B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.

____ Someone else did it for me.

____ I never do that activity, with or without help from someone else.

____ I sometimes do that activity, but did not have the opportunity since the last time I answered these questions.

____ Other.

30A. Eat half of a sandwich or finger foods

_____ Yes

_____ Amount

_____ How Well

_____ No (skip to Section B)

30B. Why did you not do the activity or use the affected arm as you did the activity, since the last visit? (Check all that apply)

____ I used the unaffected arm entirely.
____ Someone else did it for me.
____ I never do that activity, with or without help from someone else.
____ I sometimes do that activity, but did not have the opportunity since last visit.
____ Other.

APPENDIX E

APPENDIX E: WMFT SCORESHEET

Wolf Motor Function Test
Data Collection Form
(revised 5/97)

Subject's Name: _____ Date: _____

Test (check one): Pretreatment_____ Postreatment _____

Arm Tested (check one): Affected_____ Unaffected_____

	Task	Time	Functional Ability	Comment
1.	Forearm to table (side)		0 1 2 3 4 5	
2.	Forearm to box (side)		0 1 2 3 4 5	
3.	Extend Elbow (side)		0 1 2 3 4 5	
4.	Extend Elbow (weight)		0 1 2 3 4 5	
5.	Hand to table (front)		0 1 2 3 4 5	
6.	Hand to box (front)		0 1 2 3 4 5	
7.	Weight to box		_____lbs.	
8.	Reach and retrieve		0 1 2 3 4 5	
9.	Lift can		0 1 2 3 4 5	
10.	Lift pencil		0 1 2 3 4 5	
11.	Lift paper clip		0 1 2 3 4 5	
12.	Stack checkers		0 1 2 3 4 5	
13.	Flip cards		0 1 2 3 4 5	
14.	Grip strength		_____kgs.	
15.	Turn key in lock		0 1 2 3 4 5	
16.	Fold towel		0 1 2 3 4 5	
17.	Lift basket		0 1 2 3 4 5	

APPENDIX F

APPENDIX F: MMSE SCORE SHEET

Mini-Mental State Exam

	Maximum Score	Score	Instructions
Orientation:			
What is the (year) (season) (date)(day)(month)?	5	_____	Ask for the date. Then proceed to ask other parts of the question. One point for each correct segment of the question.
Where are we: (state)(county) (town)(hospital)(floor)?	5	_____	Ask for the facility then proceed to parts of the question. One point for each correct segment of the question.
Registration:			
Name three objects (bed, apple, shoe). Ask the patient to repeat them.	3	_____	Name the objects slowly, one second for each. Ask him to repeat. Score by the number he is able to recall. Take time here for him to learn the series of objects, up to 6 trials, to use later for the memory test.
Attention and Calculation:			
Count backwards by 7s. Start with 100. Stop after 5 calculations.	5	_____	Score the total number correct. (93, 86, 79, 72, 65)
Alternate question:			
Spell the word "world" backwards.	5	_____	Score the number of letters in correct order. (dlrow = 5, dlorw = 3)
Recall:			
Ask for the three objects used in question 2 to be repeated.	3	_____	Score one point for each correct answer (bed, apple, shoe).
Language:			
1. Naming: Name this object. (watch, pencil)	2	_____	Hold the object. Ask patient to name it. Score one point for each correct answer.
2. Repetition: Repeat the following--"No ifs, ands or buts."	1	_____	Allow one trial only. Score one point for correct answer.
3. Follow a 3-stage command: "Take the paper in your right hand, fold it in half, and put it on the floor."	3	_____	Use a blank sheet of paper. Score one point for each part correctly executed.
4. Reading: Read and obey the following: Close your eyes.	1	_____	Instruction should be printed on a page. Allow patient to read it. Score by correct response.
5. Writing: Write a sentence.	1	_____	Provide paper and pencil. Allow patient to write any sentence. It must contain a noun, verb, and be sensible.
6. Copying: Copy this design. 	1	_____	All 10 angles must be present. Figures must intersect. Tremor and rotation are ignored.
	Total Score		(Max. 30) Test is not timed.

Reprinted with permission. Folstein MF, Folstein SE, McHugh PF. Mini mental state. A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research* 1975; 12:189–198.

APPENDIX G

APPENDIX G: LOII SCORE SHEET

Leisure Occupations Interest Inventory (LOII)
(A tool to help client identify leisure activities in which to engage)

Directions:

1. The therapist should go through the list of categories with the client to identify which activities the client enjoys or has enjoyed in the past
2. The client should identify the level of current interest (e.g., high, medium, or low) for each leisure occupation. *High interest* means that a person would like to, or does, incorporate the activity into a daily or weekly schedule. *Meduium interest* means that the individual enjoys the activity and would or does engage in the activity when he or she has time. *Low interest* means that an individual either has no interest or engaged in the activity occasionally, such as 1–2 times a year.
3. The therapist and client together should identify a goal for participation in the leisure occupation. The goal should include the specific type of activity and the amount of time spent either daily or weekly. Example of a targeted goal: gardening, including pruning, cultivating, and planting, 1½ hours daily before breakfast.

Category and Examples of Specific Activities	**Degree of Interest**			**Targeted Goal, including** • ***specific activity*** • ***time spent (daily, weekly)*** • ***time of day spent***
	H	M	L	
HORTICULTURE • *working in garden* • *growing plants* • *identifying different plants* • *arranging flowers*	x			Working in the garden, 1½ hours daily before breakfast
SPECTATOR • *watching live sports*			x	Attending football game once a year
SPORTS • *engaging in competitive and noncompetitive sports*		x		Playing tennis once a month
MUSIC • *listening to music* • *playing an instrument*				

Figure 11–1. The *Leisure Interest Inventory* (ILS; Stein & Cutler, 1997) can be used to assess leisure skills for clients who have psychosocial deficits. This may be reproduced at will providing the authors are given credit. Please send comments regarding this form to Dr. Frank Stein, Occupational Therapy Department, University of South Dakota, 414 E. Clark St., Vermillion, SD 57069.

Category and Examples of Specific Activities	Degree of Interest			Targeted Goal, including • *specific activity* • *time spent (daily, weekly)* • *time of day spent*
	H	M	L	
COMPUTER ACTIVITIES • *interactive games* • *"surfing" for information on Internet or the Web* • *word processing* • *analyzing data*				
READING • *books* • *magazines* • *newspapers*				
ARTS AND CRAFTS • *woodworking* • *sewing* • *hand crafts*				
CREATIVE ACTIVITIES • *composing, creating, or designing: oil painting, poetry, musical composition, furniture, weaving*				
SOCIAL • *being a member or participant in a club, church group, or organizational support group*				
EXERCISE • *relaxation or aerobic exercises for health and wellness, such as stretching, walking, yoga, T'ai Chi*				
PET OR ANIMAL CARE • *caring for and bonding with animals and pets such as cats, horses, and dogs*				

Category and Examples of Specific Activities	**Degree of Interest**			**Targeted Goal, including** • *specific activity* • *time spent (daily, weekly)* • *time of day spent*
	H	M	L	
TABLE OR MIND GAMES • *chess* • *crossword puzzles* • *card games*				
DANCE • *ballroom* • *disco* • *square dancing*				
COLLECTING OBJECTS • *stamps* • *thimbles* • *coins* • *dolls* • *cards*				
SELF-CARE • *hair restyling* • *taking a bath* • *grooming* • *planning wardrobe*				
TELEVISION OR RADIO • *watching or listening to favorite programs*				
VOLUNTEERING • *engage in altruistic or philanthropic activities such as community service in library, hospital, or school*				
SHOPPING • *window shopping* • *gifts* • *clothes* • *books or CDs* • *household items*				

Category and Examples of Specific Activities	Degree of Interest			Targeted Goal, including • *specific activity* • *time spent (daily, weekly)* • *time of day spent*
	H	M	L	
CULTURAL ACTIVITIES • *visiting museums and art galleries* • *travel* • *attending symphonies, concerts, theater, lectures*				
CULINARY ACTIVITIES • *restaurants* • *gourmet cooking*				
REPAIRING AND REFINISHING OBJECTS • *car repair* • *household repair* • *refinishing furniture* • *painting rooms* • *sorting closets* • *cleaning*				